**S T A N F O R D U N I V E R S I T Y**

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| PROJECT: | STANFORD FACULTY ORAL HISTORY PROJECT |
| INTERVIEWEE: | WILLIAM F. SHARPE |
| INTERVIEWER: | NATALIE MARINE-STREET |
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| PART: | 1 OF 4 |

**Marine-Street:** This is Natalie Marine-Street with the Stanford Historical Society Oral History Program. Today is August 22, 2018, and I'm here with William F. Sharpe, STANCO Professor of Finance Emeritus at the Stanford Graduate School of Business. We're speaking to Professor Sharpe as part of the Stanford Faculty Oral History Project. I was hoping we could start today, Professor Sharpe, by asking you to tell us where and when you were born, and something about the family that raised you.

**Sharpe:** [00:00:32] All right, I'd be happy to. I was born in 1934 in Cambridge, Massachusetts. My father at that time was an administrator at Harvard, and my mother was a housewife, I guess you would call it in those days. I grew up there my first few years, but my father was in the National Guard. His unit was called to active duty before Pearl Harbor and moved to Texas to a little town called Bay City, where they were building what was actually quite a large base that is no longer [there].

He was in the Coast Artillery, and so the day after Pearl Harbor, he was transferred to Vallejo, to Mare Island, presumably to protect the shipping operations there. We moved to Vallejo, and then after not too many months, he was transferred to Riverside in Southern California to Camp Haan, which was huge. It was like a city, but after the war, they scraped it off. So he was there, and we moved to Riverside.

[00:01:57] He was then transferred to Washington, and my mother and I decided to stay in Riverside. The schools were chaotic during the war because of the masses of people who would be moved in and moved out, and the Riverside public schools were very good. So we stayed in Riverside and I pretty much grew up in Riverside until I went away to college.

**Marine-Street:** Did you have any siblings, or was it just three of you?

**Sharpe:** I had no siblings. My mother remarried, and so I had a half-brother. My father remarried, so I had a half-sister. My father, after the war, settled in the Bay Area, and my mother stayed in Riverside. She had been in retail during the war and then went back to school and earned a master's in education and a teaching credential. She became an elementary school teacher and then a principal.

**Marine-Street:** [00:03:00] Where were your parents from originally? Were they from Massachusetts?

**Sharpe:** No, they were both from Rhode Island. My mother was from Providence and my father was from a small town called East Greenwich, very near

Providence. You can't get very far from a city in Rhode Island and still be in Rhode Island.

**Marine-Street:** That's true. Did you know your grandparents growing up?

**Sharpe:** I knew my paternal grandmother, and I knew my maternal grandmother quite well. My mother's father had died when my grandmother was quite young. She was a schoolteacher. So I didn't know him, and my father's father had died when I was I think six months old, so I didn't really know him.

**Marine-Street:** [00:04:00] I think I remember you saying that your father's family had small businesses or something?

**Sharpe:** My father's family in the town of East Greenwich had the Sharpe Hardware store, and I don't know exactly how far back it went. It certainly went back to the early 1900s, I believe. So that was the family business. That changed. The family business, throughout my family, became education.

**Marine-Street:** I've heard you say that before, and I wonder, how did that manifest itself when you were growing up, that value on education?

**Sharpe:** [00:04:43] I can tell you a story, and this will be fairly complicated. I started at UC Berkeley, and my mother wanted me to be a doctor. I took physics and chemistry, and decided that I really didn't like the sight of blood and that being a doctor wasn't a particularly good channel for me.

So I went to UCLA, expecting to be a business major, and in my first semester I took Econ I. I had no notion what economics was. There was no

economics in high schools in my day. I took an accounting course and then political science. I thought this economics was really interesting, so I switched and became an econ major.

Then, back to your question, when I was a senior looking for a job, I'd had had jobs during college, but I was interviewing mainly at banks. I remember one interview in particular. The interviewer looked at the front page of my resume and said, "Well, you have really good grades."

[00:06:08] I foolishly said, "Thank you. That's nice."

Shortly thereafter he said, "You know, I think you should really go to graduate school and not come to work for our bank."

So after that, when the interviewer would sit down, I would turn the resume over and say, "Look, I was commodore of the sailing club, and I was, briefly at least, in a fraternity, and I'm actually a rounded human being." But in any event I chose to get a master's. I had to go into the service after the master's in economics.

**Marine-Street:** [00:06:49] So I'm trying to get a sense of you growing up as a kid. What kind of a kid were you? What did you like to do for fun?

**Sharpe:** I suppose in today's jargon you would have called me a nerd. I remember in probably fourth grade or fifth grade, making some sort of a little thing in a box with a light and a battery. I can't remember what it was. The teacher saw me playing with it under my desk, and I remember she talked to my mother and said, "You know, Billy is easily bored in classes. He's doing well,

but.… " I built amplifiers and things, and I worked in a garage the last year of junior high and all through high school. I had a motor-scooter and I rebuilt the engine. I was sort of doing stuff like that.

**Marine-Street:** [00:08:05] Tinkering around with things.

**Sharpe:** Tinkering, yes.

**Marine-Street:** You had mentioned World War II, and of course that would have come at a pretty formative time for you. What are your memories of World War II and those moves that your family had to make?

**Sharpe:** Just the dislocation aspects. When we moved to Vallejo, there were just no apartments to be had. An apartment would go, they would post a notice, and at four a.m. people would be queuing up trying to rent it. I remember we were living in a hotel and my mother went out every day trying to find a place to rent, and she finally did. The schools in Vallejo were on triple sessions, not double but triple, because of the huge influx, because of Mare Island and the military.

**Marine-Street:** [00:09:02] No kidding.

**Sharpe:** So it was chaotic, and when we moved to Riverside it was in the spring. I remember I had to take I don't know many tests, but one of them was multiplication tables, and I flunked elevens and twelves because in Riverside you had to memorize multiplication tables through twelve and in Vallejo it was through ten. So I had to repeat fourth grade.

**Marine-Street:** The whole year of fourth grade they made you repeat?

**Sharpe:** I did. But it was just as well, because I was already almost three years ahead. I was still pretty much the youngest person in my classes, so it was good that I repeated fourth grade.

**Marine-Street:** Was that hard being the youngest? Was that awkward?

**Sharpe:** Yes, it was not comfortable at phys-ed time.

[00:10:00] But to go back to the war, I didn't really answer that. I think people who didn't live through that have no concept of how pervasive the effect of the war was. The wars we've had since, or whatever you want to call them, have affected us, but only a few in this way or that way. The entire society and economy was totally changed. We had rationing, but everybody had someone in the family--not everybody, but it seemed like everybody--who was in the war, or in the service, not necessarily overseas.

People were losing people, family members, and there was government propaganda everywhere. Some of it was, by today's standards, unconscionable, but it was all-consuming. The story of Rosie the Riveter--a huge number of women went back to work, or went to work, where before they had not and would not. So it was everywhere, and even for a relatively young child, it was pervasive.

**Marine-Street:** [00:11:28] Do you remember doing any of the scrap salvaging, or gardening, or any of those kinds of things?

**Sharpe:** Well, we certainly changed our diets. We did air drills, where we would turn off all the lights and hide in a room with no windows until the all-clear.

Again, it was ever-present, and it affected virtually everybody I knew.

**Marine-Street:** Was that the time when your mom went out to work outside the home?

**Sharpe:** Yes, and shortly after we moved to Riverside. She was working long hours, but everybody was working long hours. After school, you did something with your friends. We were all very self-sufficient, which I count as a good thing. Those were the days when you could ride your bike three miles to school, or one mile, or a motor-scooter or a motorbike--I had them all--and when you could just go to somebody's house afterwards.

**Marine-Street:** [00:12:39] Hang out.

**Sharpe:** Yes. There were no helicopter parents in those days.

**Marine-Street:** Yes. That's the way I remember it as well. What about things like the movies or reading? Were you into any hobbies other than tinkering?

**Sharpe:** I certainly read quite a bit and went to the movies some. Television was coming, and I remember our neighbor, who was a doctor, had a television set. We would go over there, or I would go over there--my mother wasn't much interested--and watch *The Milton Berle Show*. One summer I did massive amounts of gardening and yard work for friends and others and earned enough money to buy a television.

[00:13:27] The screen was seven inch diagonal, and it was sort of a console television. I put up an aerial, and I can't even begin to describe how bad the quality was. We got two stations from LA. Then I bought a bubble, which made the screen look bigger. It was sort of flat with a rounded front,

like a big magnifying lens. So I was very popular. We had television parties, and my friends came over to watch television.

**Marine-Street:** That's great, on the bubble lens television. That's a great story.

**Sharpe:** It was a Motorola, I think.

**Marine-Street:** Now you were at Riverside Polytechnic? Was that the name of your high school?

**Sharpe:** [00:14:18] Yes, public schools all the way through, excellent schools.

**Marine-Street:** Did you have any teachers there that were a special influence on you?

**Sharpe:** I did. One in particular, I didn't actually take courses from him, but he was in charge of the high school annual, and myself and two of my best friends were the photographers for the annual. We spent a lot of time at that activity, and he was very influential. He was a strange duck, Mr. Kelly, but very, very smart, and we liked to think we put out a great annual.

I had an English teacher, Bill Bell, who I think also taught in the night program for USC--smart. I remember he had a party at his house once for some of the classes, and he had some of us down to his place in Laguna. We dove for abalone, would you believe, and then barbecued them. He was brilliant and just a marvelous guy.

[00:15:28] Then there was Mr. Casey, a chemistry teacher. I wasn't all that interested in chemistry, but there was something about him. He was so intellectual and so fascinated by, in this case, chemistry. He's a very lingering memory.

**Marine-Street:** That's interesting to me that none of those teachers had anything to do with math subjects. That goes on to be a big part of your life and the finance, *et cetera*. Was there any indication?

**Sharpe:** I don't remember who taught math, and I didn't think of myself as being interested in math, or physics, or chemistry, for that matter. I hadn't really thought much about it, other than my mother wanted me to be a doctor, so I took some physics and chemistry.

**Marine-Street:** [00:16:35] That's interesting.

**Sharpe:** There's another aspect of that. My freshman year at Cal, I decided to be an activities major and lived in a dorm the first semester. Then I pledged a fraternity. I actually ran for junior or sophomore class president. I lost, [laughs] and so I sort of burned the candle at a few ends. Then I got over that and decided to become more serious when I went to UCLA.

**Marine-Street:** When you say activities major, you're being facetious, or was there really an activities major?

**Sharpe:** Oh, no. I'm being facetious. I'm intending to be droll. Let's put it that way.

**Marine-Street:** [00:17:17] Okay, there you go.

**Sharpe:** It was a term of art in those days.

**Marine-Street:** So you were doing a lot of activities rather than concentrating on your studies.

**Sharpe:** I was, and I did not get great grades. I rectified that when I went to UCLA.

**Marine-Street:** When you went to UCLA, did you live at home, or were there dorms?

**Sharpe:** No, I pledged a fraternity, Theta Xi, when I was at Cal. Then I lived briefly in the fraternity house at UCLA, but I just couldn't get anything done. So one of the young pledges, I guess he was at that point, and I rented a little room in the back of somebody's yard in Westwood and stayed involved with the fraternity. We ate there periodically and went to meetings and such, so we were still involved, but that turned out to be much better in terms of getting work done. It actually turned out to be cheaper, so it was a win-win.

**Marine-Street:** [00:18:27] Than living in the house? Was the fraternity a big part of your life all through college?

**Sharpe:** No, I have to say not really. I sort of lost interest in it and maintained a kind of a tangential tie with it.

**Marine-Street:** Now you had said that education was the family business, so their expectation was definitely that you would go to college. There was never any question about that?

**Sharpe:** There certainly never was any question. My friends all went to college, and it was much easier in those days. I went to the advisor at Poly High. We talked a little bit, and I said, "I'd really like to go to Cal."

[00:19:18] He said, "Okay. Here's what you do, and the forms," and I was admitted. I had very good grades, and Cal at that time--I'm sure they still do, and I'm sure most universities do--kept records as to how well graduates of that high school, at least in California, did when they went to Cal. The record of Riverside Polytechnic was very good, I had very good

grades and the record of Poly was very good. So I was admitted, and I didn't apply anywhere else. Going through what our grandchildren have gone through trying to get in to college, it's a totally different world.

**Marine-Street:** Yes, it's really changed, and there's a scarce goods kind of mentality about some of the schools that puts a lot of pressure on people.

**Sharpe:** [00:20:14] There certainly is, and of course a lot higher percentage of the population is going to college.

**Marine-Street:** Oh, that's true. Right.

**Sharpe:** Which is a good thing.

**Marine-Street:** Then your parents had both been to college, and had your grandmothers been to college as well? Or it's teaching school, maybe?

**Sharpe:** I really don't know. Those were early times, but she was a schoolteacher all her life. She ran a girls summer camp in New Hampshire in the summer to get more income. She had two girls to raise. But I don't know.

**Marine-Street:** Interesting. How about financing college? Was it very expensive in those days, or how did you manage that?

**Sharpe:** [00:21:07] By today's standards, no. Even adjusting for changes in the cost of living, in-state tuition was ludicrously low. It was I think possibly two hundred. At some point it [changed] from semester to quarter system, but I'm remembering sixty-five dollars a quarter or something like that.

But I do remember one year when I was a TA or [a reader]. When I was an undergraduate I graded a lot of papers and was a reader. In the

master's program I was a teaching assistant, but at some point somebody messed up the accounts, and they didn't cut the first check to the TA's. The registration fee was due, and we basically said, "We're going on strike," because many of us could not pay the pitifully small registration fee until we got our first TA check. I worked in gas stations and such, and read papers. My father helped a little, but I pretty much bought myself through.

**Marine-Street:** [00:22:38] Wow.

**Sharpe:** It was a lot easier to do in those days.

**Marine-Street:** That's right. So you're at UCLA. How did you decide that you wanted to get into economics?

**Sharpe:** As a business major in my first semester I had to take Economics I, which was microeconomics, taught by a man named Marvel Stockwell--it was a big lecture class with TA-led sessions--and accounting. I just loathed the accounting course because it was really a bookkeeping course. It wasn't accounting as we now teach it in many business schools, and it had very little what I would call intellectual content.

[00:23:25] I just fell in love with microeconomics. You could make some plausible assumptions about people's preferences and get this thing called a demand curve, and you can make plausible assumptions about production of goods and services and make this thing called a supply curve. Where they crossed would be the equilibrium price and quantity, and then you can look at different issues about taxation. I just thought it was

beautiful, so I changed to an economics major. I had no notion how I would earn a living, but I just had to do it.

**Marine-Street:** At this time, there's no kind of computers or anything that are involved in your life as an undergraduate?

**Sharpe:** As an undergraduate, no, but very shortly after, my master's, and then the six months in the Army, and when I went to RAND Corporation.

**Marine-Street:** [00:24:24] Anything else from undergraduate days that sticks in your head as significant experiences?

**Sharpe:** One semester or summer, I worked as a research assistant for a faculty member in the business school. He was a trained economist and a huge influence on me. We can talk about J. Fred Weston. I became very close to him and learned a huge amount working for him. That was as an undergraduate, so that was a major influence, and of course the faculty in economics. We can talk about them too.

**Marine-Street:** Before we do that, tell me a little bit about ROTC. When did you join ROTC?

**Sharpe:** [00:25:20] I joined ROTC probably when I transferred to UCLA. Those were days when people were being drafted, [laughs] and if you joined ROTC in college, you had an obligation for service but you also got paid. By today's standards it was ludicrous, but in those days it made a difference.

So I joined ROTC at UCLA, and the obligation was two years of service or special conditions. You could do six months and then

seven-and-a-half years of reserve duty, which was a meeting a week and then two weeks in the summer. So that's how I got into ROTC, and they allowed me to defer my active duty for a year in order to take the master's degree.

**Marine-Street:** The Korean War was going on at the time, so there was a real kind of fear that you could get called up if you went on active duty.

**Sharpe:** [00:26:34] Many of us thought it was a certainty, but I was not averse to being in the service. My father had been in the service, and I happened to believe that it would be good for society if everybody, male and female, had some required service. It could be Peace Corps. It could be military, whatever. Switzerland, if you look at Switzerland, Israel. Because of my experience in the service, watching people forced to live together and understand that people of different backgrounds or colors are human beings, in those days in particular, I just think it's a very good thing. And I was in the best shape of my life when I was on active duty. [laughs]

**Marine-Street:** Yes, I bet. With ROTC while you were an undergraduate, did you have to go to classes or something that were ROTC classes?

**Sharpe:** [00:27:35] Yes. I don't remember it a lot, but we had to go to classes. I was in high school ROTC too, and there we had companies and drilled, and parades and things. I don't recall anything like that, and I think it was a much lower level of activity.

**Marine-Street:** Do you think there are any principles that you took away from ROTC in that? I know it was a brief experience, but it was a formative time for you,

too.

**Sharpe:** Probably not ROTC *per se*. Active duty, yes, as I've said. I learned a lot about the world and people in the world on active duty.

**Marine-Street:** Where were you on active duty again?

**Sharpe:** I was in Fort Lee, Virginia. We also spent six weeks in the summer between our junior and senior years at Fort Lee.

**Marine-Street:** [00:28:34] What was going on at Fort Lee?

**Sharpe:** That was the quartermaster headquarters, and I was in a petroleum depot company when I was on active duty. Basically, in the event of hostilities, we would probably be flown in and we would lay pipelines from let's say the shore where the tankers could come to where they needed it for tanks.

We came very close in the Suez Crisis. We were on heightened alert and we had to be able to be on post within four hours. I lived off campus when I was on active duty. We came very close to active duty but did not actually do any. I was on active duty formally, but without being involved in the back lines of a combat situation.

**Marine-Street:** [00:29:34] So you would have had to figure out how to be an engineer, then, to go in and actually lay those pipelines?

**Sharpe:** I didn't actually have to do that as much. My great triumph, and it's off-subject a bit, but it goes back to education: I was a second lieutenant. We had a company commander and then an executive officer who was sort of assistant company commander--two incredibly smart, full-time military,

and I had about twenty different duties.

I found out that on post we had a [GED] program where the men--they were all men, of course--could go to half a day, and take courses, and ultimately get a [GED] high school equivalency certificate. The vast majority of our troops, our enlisted men, did not have high school degrees, and so I gave an impassioned speech about how wonderful this would be and why they really ought to do it. Besides which, if they did that, they would get out of all the extra duties like mess hall, latrine, *et cetera*.

[00:30:55] I signed up a substantial proportion of the members of the company to go into the [GED] program, earning me the enmity of the others who had to pull more KP and latrine duty as a result. But I liked to think that I had some positive influence on the lives of at least some of the guys.

**Marine-Street:** In your unit, there were people from all over the country?

**Sharpe:** Most of them were from the South. There was a draft then, and they tended to be from the South. We were in the South. I don't know if that was why, but yes, they were all over, and it was very bi-racial, and it was an amazing thing to see the effect of this close contact which many of them had never experienced.

**Marine-Street:** [00:31:50] What was it like in Riverside in terms of the racial composition at your high school?

**Sharpe:** We had a very large Hispanic population. There were two areas, one in

Riverside and one between Riverside and the next town, that were very heavily Hispanic. Our student body president was Hispanic. There were some black students, but I would say the majority was white. The largest minority was Hispanic, and then the next largest would be black.

By today's standards, probably we would call it racially segregated, but by the standards of the day, it seemed to me that we were pretty well mixed and everybody got along. But I'm sure if you looked at the specifics of who married whom and all the rest, you'd find it pretty compartmentalized.

**Marine-Street:** [00:33:04] Let me ask you why did you decide that you were going to go to graduate school?

**Sharpe:** Well, because the banks wouldn't hire me, [both laugh] and I wasn't sure what I was going to do when I got out of the service. I assumed that probably I'd go to work for government. Fortunately, there was Armen Alchian, who was one of the other huge influences in my life, a microeconomics professor whom I'd gotten to know well. I didn't work for him, but I took a whole three-quarter sequence from him in microeconomics, PhD-level and graduate-level, at least, for my master's.

[00:34:04] At the time, the RAND Corporation in Santa Monica had a lot of economists, and they had consulting agreements with a fair number of the economists at Stanford and UCLA, including Armen Alchian. Armen asked me, as I finished the master's, if I would like to work at RAND when

I got out of the service.

I said I certainly would, and then when I was on active duty I found that you could apply for the six-month plus eight years of reserve, seven-and-a-half, if you went to work for a government contractor, which RAND was. So that's how I got out in six months and worked at RAND. When I was at RAND I was incredibly happy, but at some point I decided I really would like to teach at a university. That's another story which we can discuss.

**Marine-Street:** [00:35:19] What did your parents think of this decision to pursue graduate education?

**Sharpe:** Oh, they were all for it. My father was at that time the head of Golden Gate College--now University--in San Francisco. After the war he had gone to Golden Gate, and while there he took a PhD in education at Stanford. My mother was by then an educator, and my grandmother had been an educator. Now, my cousin is a professor at UVA in Virginia, as is her husband. My children are in education. It's the family business.

**Marine-Street:** It just occurred to me that in that post-war period, there would have been a lot of demand for educators. Is that right? [Sharpe laughs]

**Sharpe:** [00:36:14] I couldn't have picked a better time to be born. [laughs] It was just that all the colleges and universities were expanding their faculty, and it was a golden time.

**Marine-Street:** Tell me a little bit about what your graduate education was like, because you

were working at RAND while you're getting the master's and the PhD, correct?

**Sharpe:** No, I wasn't working at RAND when I got the master's. On the master's, I was a teaching assistant. RAND Corporation was just a little bit. We used to say RAND stands for "Research and No Development." It was during the second war, when there was a group of intellectuals, let's call them, working for the Air Force. After the war General Hap Arnold, a legendary general, decided that the Air Force really needed that kind of talent. But he realized that after the war was over he wouldn't get it as civil servants working for the Air Force, so he established this research organization. He also thought, to keep its independence it should be at least ten hours by plane from Washington, and so that's why it ended up in Santa Monica.

It was just an amazing place. They also were absolutely delighted to have people take graduate work, and you could adjust your schedule. They would even pay some of the tuition, and it was not discouraged or tolerated; it was encouraged. I like to think I gave RAND a full-time output and perhaps more, but it was very easy for me to take the courses at UCLA and do the work.

**Marine-Street:** [00:38:29] The courses would have been probably during the day, but they were flexible about that?

**Sharpe:** Yes, for some reason it seemed to me they tended to be in the afternoons, but I worked nights and weekends. I'm a workaholic, was and am, and they

were just fine about it.

**Marine-Street:** Let's go ahead and talk a little bit about RAND. Did you have to interview for that job? Do you remember how you actually got the job?

**Sharpe:** I don't think I did. I think Armen talked to them, and I'm sure there was correspondence, and of course there was the [security clearance]. In those days you had to be in an area where there was no classified material while you waited for your security clearance. I went through that process, but I don't think there was any question that I was going to be hired unless I flunked security.

**Marine-Street:** [00:39:34] You said it was in Santa Monica. Could you just describe the setting a little bit for me, physically?

**Sharpe:** RAND Corporation is still in the same location. The buildings now are grander and more complicated, but it was one block above Santa Monica Pier.

**Marine-Street:** Nice.

**Sharpe:** At lunchtime you could go down and watch the wrestlers and go for a swim or do some bodysurfing if you wanted to. It was an amazing place. Stanford connections: when I was there, Ken Arrow, a famous economist, was consulting and he was there off and on. George Dantzig, the creator of linear programming, was there full-time. He subsequently went to Stanford.

[00:40:28] There was all this intellectual communication with various universities. One of their policies was you should work on RAND projects

four days out of five, but one day out of five was yours to do any kind of research on anything you wanted. So you could not design a better place. It was the beginning of the operations research movement, and RAND was in the center of all the creative work that was being done at that time.

We had a computer we called the JOHNNIAC, which had been designed by John von Neumann, one of the great creators of operations research, economics, mathematics, you name it. So it was just the best possible place to be.

**Marine-Street:** [00:41:34] Now were you part of a unit or department or anything?

**Sharpe:** Yes, there were several departments: computer science, although I think they didn't call it computer science. Maybe it was computer department. There was I think an operations research department, and there was an economics department. I was in the logistics department, which was populated mostly by economists.

Probably our biggest project was--I'll trivialize it, but it'll give you the idea. If the Air Force needs to be prepared to deal with situations anywhere, to sort of take the extremes, you could either have a bunch of smaller planes stationed at various places around the world, or you could have big planes stationed in the US. In particular, if you think about carrying troops, Army troops, let's say, to a combat area, you could either have smaller transport planes, lots of them stationed hither and there, or big ones stationed in a couple of places in the states.

[00:43:03] The question was, which is cheaper? I'm wildly oversimplifying. To do that, we set that up as a huge linear programming problem using technology that George Dantzig and others had developed, and then each of us had a particular domain to get the empirical information to fill in parts of this gigantic matrix table of numbers. Then we thought, at the time at least, when we actually ran the final program, that it was possibly the biggest linear programming problem ever solved at that time.

So that's the sort of thing we did, but this one day off we did all kinds of other things. I remember that there was a tradition there that you left your door open, and anybody could wander in and say, "You know, I'm working on this problem. Let's talk about it."

[00:44:12] One day a bunch of us were just talking in general. There was smog in the LA Basin, and we started talking, "Well, we're economists. If something is bad, you tax it. Maybe there should be a smog tax." So we did some little theoretical models, and then I remember we went down one day to the air pollution control district that thought we were absolutely [laughs] out of our minds, and we published a proposal for a smog tax. RAND had different levels of publications. There was a D, a document, which was a public domain. We were encouraged to write public domain documents, so that document was one.

[00:45:00] I was involved in several of them. We never got it published anywhere, but it was very simple. The idea was that the area

within the LA Basin was relatively well defined. Most of the smog was within the Basin, and you had to drive over some little mountains to get out of the Basin. Our idea was that you would add a smog tax to fuel. People could keep their receipts for how many gallons they had bought, and then they could have their car inspected every two or three years, figure out how much pollution it produced per gallon of gasoline, and then the system would then give them a rebate on what they'd paid in smog taxes, depending on how much pollution their car produced.

**Marine-Street:** Their car was creating.

**Sharpe:** We thought that was very, very cool, and nobody had even thought about that at that time. It was very early on. That was just the ethic of the place.

[00:46:00] "Oh, you know, I've been thinking about this problem," or "I read something in the.… " Just what you would do in a good academic institution. "Let's have lunch, and I'm thinking about this smog problem, and maybe something economic could do it as an externality, what have you." Plus, I learned all about computers, and programming, and operations research. It was an astounding place.

**Marine-Street:** Did you have a supervisor?

**Sharpe:** There was sort of a principal in each project, but the logistics department had what we would call an academics a chair. I can't remember what we called it at RAND. In our case, [there was] a very, very smart British economist. I remember [laughs] the ethic sort of was, when you came up

with an idea [you'd say], "Here's a study that would be really useful," and you could present it to him and then two or three of the others, at least.

[00:47:17] I remember the first thing he asked, he said, "I want you to show me the graph that's at the end of your presentation when the study is done. It doesn't have to have anything in the middle, but I want to know what's on the axes. I'm going to show you the relationship between this and that, which was very good discipline."

You would basically come up with an idea of something that would be beneficial to the Air Force but was a hard problem that required some serious analysis of some sort or another, and then present it. Then he or others said, "That's fine. Go for it." Then there was kind of an ethic that, "If you produced something really useful every three years, that's just fine, because we really want you to take chances. Work on problems that are hard enough that you may not solve them."

**Marine-Street:** [00:48:17] It seems incredible to me. It seems so twenty-first century, having you work one day a week. That's like Silicon Valley says that.

**Sharpe:** Well, no, you work four days a week, but then you get one on your own.

**Marine-Street:** Well, I'm sorry. One day a week on your own.

**Sharpe:** There were all the academics who came and went, and maybe spent summers, so it was sort of like the research part of a great university without the teaching, [laughs] although RAND subsequently did set up a PhD program which still exists. That's long after my day.

**Marine-Street:** Oh, I didn't know that. Now did you know Dantzig?

**Sharpe:** [00:48:55] I didn't really know him, no.

**Marine-Street:** Would Nash have been there at that time? The *Beautiful Mind*?

**Sharpe:** Yes.

**Marine-Street:** Did you ever cross paths with him?

**Sharpe:** I didn't really.

**Marine-Street:** That's very interesting.

**Sharpe:** Well, I'm not sure. I got to know John well from Nobel things, but I'm not sure he was there at that time. I was there for several years. Then I went to Washington. Then I went back to RAND for a year and I also spent some summers at RAND. So my time at RAND was sort of checkered.

**Marine-Street:** I want to ask you just a couple more questions about RAND, and then we'll take a break. Was it formal dress in those days?

**Sharpe:** [00:49:38] Oh, God, no. [laughs] Remember, I told you it was near the beach. Let your imagination run. No.

**Marine-Street:** So people could just dress casually.

**Sharpe:** Oh, absolutely.

**Marine-Street:** Did the Air Force brass ever show up to check you guys out?

**Sharpe:** They did, and I think they thought we were members of some different species, but they liked the output. I will say, about this project I was mentioning to you, I did a sort of a sub-study, to put it wildly simplified, on how many Army trucks of different kinds you can get in a transport plane of

a particular configuration, because we needed those numbers. So I spent a fair amount of time out at George Air Force Base basically getting data and working with some of the people on the lines, pilots and depot people.

**Marine-Street:** [00:50:47] Measuring the trucks and that kind of thing?

**Sharpe:** Yes, or getting the data. I don't think I ever measured one, [laughs] and then with some Army people as well.

**Marine-Street:** So you never really did see any of your research get developed while you were at RAND. Is that what you were saying about the acronym?

**Sharpe:** Well, I hope the Air Force made a number of decisions based on some of our studies. A fair amount of it was classified. Also I should tell you that when I went to Washington I retained a consulting agreement with RAND and took some of my early work at RAND and added to it what resulted in a book called *The Economics of Computers*. I had done some early work on the pricing of IBM computers, and why they had a particular pricing procedure, and the economics of all of that. RAND liked that work, and they encouraged me to continue it and produce a book, ultimately.

**Marine-Street:** [00:52:01] Interesting. Okay, let's take a real quick break.

**Sharpe:** Okay.

**S T A N F O R D U N I V E R S I T Y**

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|---|---|
| PROJECT: | STANFORD FACULTY ORAL HISTORY PROJECT |
| INTERVIEWEE: | WILLIAM F. SHARPE |
| INTERVIEWER: | NATALIE MARINE-STREET |
| DATE OF INTERVIEW: | AUGUST 22, 2018 |
| PART: | 2 OF 4 |

**Marine-Street:** I wanted to ask you to expand a little more on the computers that you encountered at RAND.

**Sharpe:** Computers at RAND. This is where I got the disease which [both laugh] I have to this day. We had a computer at RAND that was one of a kind, which we called the JOHNNIAC. In some ways, and I'm not sure exactly which ways, it had been designed by John von Neumann, one of the pioneers of computers, mathematics, operations research, economics, you name it.

[00:00:46] One of the guys in the computer department came up with this idea that we could put teletype machines--big, clunky things--in little rooms around the building and develop a simple programming language so that you could just leave your office, go around the corner and into one of the rooms and write a little program in this language. Then it would do your job for you, rather than having a programmer from the computer

department come and write programs in FORTRAN II, *et cetera*, for use on the big machine. By then we had a big IBM machine--I think it was a 704.

[00:01:36] He developed a language which we called JOSS, ironically the name of one of the deans at the Stanford business school, which stood for JOHNNIAC Open Source Something. It was a very, very simple but quite elegant little language, very similar in many ways, I suppose, to BASIC, which came after it. I loved that, so I took a little course on it and started using that language and those computers.

Then the computer department decided that in order to make it possible for researchers to work more effectively with programmers on projects, they would try to get us, the researchers, to learn a little bit about programming so we could communicate more effectively. So I took a course on FORTRAN II, which was the main language on the IBM machine. I say it was the big machine. It certainly was big, but by today's standards it was ludicrous [laughs] in terms of what it could do and how long it took. But it was state of the art.

[00:02:54] I took that course and thought, "This is too much fun. Why should I let the computer people have all the fun writing the programs? I'll write my own," which I did. Then when I did my dissertation--I need to back up on the predecessor. Do you want me to say anything more about the computer situation?

**Marine-Street:** Yes, I do. I just want to get more of a sense of how you did that computer

programming in those days. Was it a punch-card situation? Could you just explain that to me?

**Sharpe:** Oh, yes. It was brutal. You had to punch not only your data but also the program statements, and you had to have punch-cards in the beginning to tell the computer, "I want you to use a particular system in a particular language."

[00:03:56] The formats were unforgiving. You had to put statement numbers in columns. As I recall, It was an eighty-column punch-card, and then I think column six or seven was reserved for continuation. Then there was a comment section. Basically what you would do is you'd prepare your program and the data, and you'd put a rubber band [around the cards] and put them in the inbox. Then you'd come back in hours, possibly, and you'd get the cards back with a stack of paper--big printout paper.

[00:04:40] If you made even the tiniest mistake, the stack of paper would say something like, "IBSYS error," which meant the operating system wasn't happy, or "Program error," "FORTRAN error," which meant the compiler wasn't happy. Then you'd have to change the cards, do it again, wait four or five hours. It was brutal.

But between my RAND research and the research for the dissertation, I became a really good keypunch operator, and I used to say, "If things go bad in the economics game, I can earn a good living as a keypunch operator." I was accurate, and I was fast. I'd do it at night, when

the keypunch machines weren't being used very much at random, and they were perfectly happy for me to do that at night. I did some of the runs for my dissertation on the UCLA computer, and I did some of them on the RAND computer, and again, that was okay.

**Marine-Street:** That's interesting. Now in those days, who staffed the computer center?

**Sharpe:** [00:05:55] I can't remember what it was called. I don't think it was called computer science. There was a computer department, and they had programmers. George Dantzig probably was in a department called Operations Research, which was the more theoretical.

**Marine-Street:** Yes, something like that.

**Sharpe:** Again, all of these connections with Stanford: the head of the computer department at one point in my tenure was Paul Armor, and one of the researchers in the group I was in married Paul and became Joan Armor. Paul moved to Stanford and headed the computer department, the computer system, if you will, at Stanford for a while.

**Marine-Street:** Interesting.

**Sharpe:** [00:06:46] Again, there are a lot of Stanford-RAND ties.

**Marine-Street:** Yes, but was it men that were running the computer, actually putting the punch-cards through?

**Sharpe:** My recollection is there were some women. There were certainly women in our group, but it was predominantly male.

**Marine-Street:** Okay. So another question.

**Sharpe:** Remember the year. [laughs] That's not an excuse. Quite the contrary.

**Marine-Street:** I had read some work that some of the earliest computer programmers were women.

**Sharpe:** Ada Lovelace and Grace Hopper.

**Marine-Street:** And some of the people that were actually talking to the machine.

**Sharpe:** [00:07:30] Oh, the movie, yes.

**Marine-Street:** Right, so I was just curious what it was like at RAND?

**Sharpe:** There were definitely women involved. Again, I didn't get to know the programming staff very well because I wanted to do my own programming, so I can't speak to that.

**Marine-Street:** Then you got these paper printouts, but you didn't have anything like a spreadsheet yet to keep track of your findings. So how did you synthesize all of this information? Do you remember?

**Sharpe:** You wrote programs, and then to the extent you had tables, let's call them, or matrices, you printed them out. There's one sort of sidelight. For my dissertation I wrote a program--it was actually in the dissertation--to solve a particular kind of portfolio analysis problem, which is a quadratic programming problem.

[00:08:34] IBM became interested in it, and they hired me as a consultant for four hours in LA. It was all public domain, so they wrote a version of it for a business computer, 1410 or something. The 704 and its successors were scientific computers, if you will. My program had been

designed for a scientific computer, and the business computer in question didn't have the same language translators, so they rewrote the program and produced it. I don't know if they gave it away--probably. But I have no notion of how much it was used.

**Marine-Street:** Very interesting. Now how did what you were doing at RAND influence your PhD dissertation work?

**Sharpe:** Therein lies a story. I seem to be full of stories today. I originally had decided on a really interesting problem that could have had some applicability to the Air Force. I hardly remember the project now, but it was the idea of dividing a company into pieces and having what's called transfer prices.

[00:10:15] If your company makes, say, an auto body and then uses the body to make an auto, you could of course organize so that you just make the auto and some other company makes the body. This is a forced example. Or you could have both activities in-house. The question is, how do you know whether it's efficient to do it the way we're doing it, or maybe outsource the body?

So there's an idea of what's called transfer prices. The body department charges the assembly department a price for the bodies, and then you have profit-and-loss statements for each of the sections of the company. That informs you as to whether or not everything is copacetic. Then the question arises, how do you set the transfer prices? Some of the

key work was done by a fellow named Jack Hirshleifer, who at that point I think was at University of Chicago. It was done using sort of typical mathematics that economists used at that time.

I was at RAND. We did operations research, and we knew about linear programming. It was my belief that you could do a much better job in structuring the theory by using a linear programming approach--mathematics and eventually computer programs--than traditional mathematics. I started working on this with the blessings of everybody at RAND and produced what I thought was about half of a dissertation. My chair was to be Armen Alchian, and Armen said one day, "Look, we just hired Jack Hirshleifer from Chicago. It's his work that you're building on, so he ought to be your chair."

I said, "That's great."

So Jack arrived. I took in my work, and I think that first half I'd actually published as a RAND document.

He said, "Give me a week."

I went back in a week, and Jack said, "This is interesting, but I don't think there's a dissertation here."

[00:12:50] Okay. I called Armen and I said, "What do I do?"

He said, "Well, I don't know." I don't know if Armen suggested it or if I came up with it. When I had sat in on, or taken, Fred Weston's doctoral class in finance, he had introduced us to some of Harry Markowitz's work.

At some point, either on Armen's suggestion or maybe on my own, I called Fred and said, "I've got this problem."

He said, "You were interested in this Harry Markowitz's work, and Harry's coming to RAND. Why don't you see if there's something there?" We can talk about that separately, but that's sort of the roundabout way that I got into my dissertation and what turned out to be a lot of my work.

**Marine-Street:** This puzzles me, though, that he thought there wasn't a dissertation there, because hadn't there been a ton of [work on it].

**Sharpe:** [00:13:50] Well, I kidded Jack [about it]. I've told that story too often, probably, and I periodically would tell Jack, when I had occasion to see him, that he was one of the greatest influences on my life. He was a wonderful guy, and he did fabulous work. Jack's work was just absolutely first-class.

I suppose he probably felt that I was not going to reach any qualitatively different conclusions, and I'm not sure that I thought I would either. But I think it's probably that he did not feel that using that different underlying mathematical structure was going to contribute that much to the understanding and the practice at an economic level. I'm guessing that.

**Marine-Street:** Interesting.

**Sharpe:** [00:15:06] But I sure am glad he did. I still think it was a really neat paper.

**Marine-Street:** Yes, a very interesting fork in the road.

**Sharpe:** Yes, I never tried to publish it.

**Marine-Street:** But that transfer analysis and your interest in transfer prices, was that

something that the Air Force was interested in, trying to be more efficient as a big organization?

**Sharpe:** Yes, there was the hope, on my part at least, that there might be some applicability.

**Marine-Street:** Were you doing that as your personal interest on your one day a week?

**Sharpe:** It was more or less that, yes. It wasn't part of a project. That was kind of my own-time thing. But again, RAND, anything you wanted to publish--there were internal documents and external documents, and the term document for us meant unclassified. You could publish anything as an internal document.

[00:16:02] I should probably tell you one more RAND story because it was a very important influence on life, and I'm blocking now on his name, which I'm embarrassed to say. In the logistics department, we had an editor, and he was a PhD in English. Every document we wrote, whether it was classified, unclassified, would go through Will--I can't remember his last name--and he would not only edit but work with us to understand why, for example, never use a passive verb. Always use an active verb. "It is found that… " Or, "It is…" No, no. You say, "I found," or "We found," or whatever.

[00:16:50] When I first started at RAND, I just wrote atrociously. It was the worst of academese. It was bloody awful. One of the PhD courses in economic history had two instructors--Warren Scoville and I can't

remember the other guy's name. One thing they made us do, every week we had to write a two-page paper. They would edit it and mark it up once for content and once for style, and between that exercise and Will teaching me how to write at RAND, I like to think I learned how to write so that people would actually read what I wrote, and to not be pedantic but nonetheless get the information out.

So those were two big influences on my writing style. My stepfather was also a bit of an influence. He was a lawyer, but he also wrote fiction, some of which was published, and he wrote magnificently.

**Marine-Street:** [00:18:05] What was your stepfather's name?

**Sharpe:** Pat Malloy.

**Marine-Street:** Oh, interesting.

**Sharpe:** He became a district attorney, an assistant district attorney, and a public defender. Very interesting. He hadn't finished college, so he was working in an administrative position and then took the bar exam by correspondence and passed it back when you could do that. You can't now in California. He became a very distinguished attorney.

**Marine-Street:** [00:18:43] Interesting. Let's talk a little bit then about your work with Markowitz and the second dissertation that ends up being your dissertation. Why were you interested in this investment question?

**Sharpe:** Again, Fred Weston had been interested in it, and I'd taken his seminar. I'd worked as his research assistant, and Harry's work was fantastic because it

involved what's called quadratic programming. Linear programming is things are linear, and in quadratic programming, things can be quadratic or linear. So it was a fascinating optimization tool.

Harry had developed an algorithm for it, and he had characterized the problem of putting together a bunch of securities into an investment portfolio as a quadratic programming problem. When I first saw it I thought it was absolutely beautiful.

[00:19:55] So Harry and I chatted, and then I talked with Fred, and I thought about things as to, "Okay, what would I do?" So my dissertation was sort of in three parts. The first was a program that could very efficiently solve a special case of this general problem, and I developed an algorithm that would [do that] very efficiently. In those days efficiency meant it would take ten minutes instead of ten hours. Those were the kinds of runtimes that [they had].

**Marine-Street:** On the computer.

**Sharpe:** Yes. I'm overstating, but computers weren't very powerful, and so if you could [cut the time]--I think my algorithm cut the time by fifty to one, something like that. Again, it was a special case of the problem. I had to make some fairly strong assumptions.

[00:21:05] So that was the first part of my dissertation and I'm sure [it was] the first dissertation, possibly the only one in economics at UCLA, to have a FORTRAN program in the appendix. That was the first part, and

that was very RAND-ian, and RAND liked that.

Then the second part, Fred Weston put me in touch with somebody who was a real portfolio manager. He was an investment advisor, and he built portfolios for his clients in LA. I worked with him to get him to put his forecasts in the format of this simplified model. Then we ran it through the program to see what portfolios it recommended and whether he thought those were good portfolios. The answer was, he didn't. Then the question was, why didn't he? Was it that he hadn't really put in his true beliefs into the program, or that he was wrong and the program was right?

[00:22:15] I'm not sure we ever resolved that, but subsequently we came to understand that this particular structure, whether the simplified version or the general, would tend to react to what seemed much too small differences in predictions. So we sort of discovered a property that was interesting enough that IBM wanted to put it on one of their business machines. Almost nobody had actually used Markowitz's procedure in practice until then.

**Marine-Street:** So that was the same program that was in your appendix.

**Sharpe:** [00:23:01] That's the program, yes.

Then the third part, I did what Armen Alchian taught me to do. As an economist, you get this thing about, "Here's a model of how people should, at least, build portfolios. What if everybody did it? What would the world look like? What would prices be?" That was what a microeconomist

would naturally think was the next stage. In those days we differentiated between normative models--here's something that tells you what to do--and positive models--here's something that tells you how the world works, or maybe should work.

[00:23:49] So I built a positive theory of capital asset prices and got some very, I think to many people at least, surprising results--that in equilibrium, if everybody were acting optimally with all the assumptions that went into it, the best thing for everybody should be a portfolio of all the stocks in their available proportions. You borrow or lend to get the right risk level, and by the way, prices of securities would conform with a relationship where the expected return was linearly related to what is now called beta. I called it something else, which is a measure of the extent to which the stock moves when the overall market moves. So high-beta stocks should have higher expected returns; low-beta stocks, lower expected returns. I wrote that up as a paper and submitted it to the *Journal of Finance* when I was at Washington.

In the dissertation version of that, it was one key missing link that I thought, "Well, it was a nice result." Armen thought it was a nice result, and Harry thought it was a nice result. I sort of pulled the rabbit out of the hat, but you could see me putting the rabbit in in the setup.

[00:25:29] I spent the first couple of months when I was at Washington thinking, "This is so beautiful; it's just too bad it isn't more

general." Eventually I realized, "Oh, wait a minute, if I make this assumption, which is much more general, I'll still get the same result." So that's what I wrote up and submitted to the *Journal of Finance*, which was rejected.

**Marine-Street:** Why did they reject it?

**Sharpe:** I discovered finally who the referee was, but they rejected it because they thought the assumptions I made were unrealistic, to which I answered, "All economic models are built on unrealistic assumptions, and the question is, is the conclusion or is what comes out plausible and in some way conforming with reality?"

[00:26:28] I resubmitted it, and then there was a change of editors. It eventually was accepted and published in 1964. I think I submitted it probably in early 1962. That was the capital asset pricing model paper, and that's the paper in particular that the Nobel Committee cited.

**Marine-Street:** Wow. It took them a while, though, didn't it?

**Sharpe:** Oh, well, yes.

**Marine-Street:** If that was in 1964?

**Sharpe:** I can't speak to the Nobel Committee, but I remember when it was published, I said at the time to myself, "This is the best paper I'm ever going to write," and then that's true; it was. [laughs] That turned out to be true. I figuratively sat by the phone because that's how you got communication in those days, or letters, and the phone didn't ring.

[00:27:23] I didn't get many letters, and I thought, "Man, I had just written the best paper I'm ever going to write, and nobody cares." But in a year, people started reading their back journals, and then of course people attacked it, and the usual things happened.

**Marine-Street:** Why did you know that that was the best paper? What was it that made you so confident?

**Sharpe:** It had this beautiful result, but it was really simple: A, diversify and hold market proportions in your portfolio, and B, in equilibrium and hopefully in the real world over the long run, at least, expected returns should be higher for stocks that swing more in market swings than for those that swing less. That's not something wrong with the markets; that's the markets working the way they should work.

[00:28:19] Those were such simple yet important results, important in the sense of, if true, they basically were new ideas, because nobody was recommending portfolios based on that sort of thing. Nobody was even measuring betas. It was maybe a sense of high-sensitivity stocks.

The underlying theory was simple and I think simple theories are beautiful. I thought it had it all, and I couldn't imagine I was going to do anything that had all those ingredients and was as novel. It was really novel. So that's why, and I was right: I haven't done anything that had all those ingredients to that extent since, but I've done some things, I think, that were pretty good.

**Marine-Street:** [00:29:23] Was your passion for this project driven by the stock question and the investment question, or was it driven by the quadratic programming?

**Sharpe:** No. It was driven by the math in it, the programming aspects of it, and the economics of it. Now I had taken an investments course from a wonderful man--he was on my committee--John Glendenning. It was a very prosaic, traditional investments course. [laughs] I'd sold a car for I think five hundred dollars, and for some reason I wasn't going to get another car for a quarter or two, so I took the course to heart.

I was taking the course, and I bought stock in Lerner Stores, which was a women's clothing chain that had new management, young. They were going to build extra stores and it was going to be great.

[00:30:32] At that point I hadn't thought that I'm not the only one who knows this. Maybe it's already in the price, because I hadn't been thinking about such things. I put four hundred dollars in Lerner Stores, and when I needed the money a few months later, I took out three hundred dollars. [both laugh] So that's my big investment experience.

**Marine-Street:** Was that your first investment?

**Sharpe:** Yes, it was.

**Marine-Street:** You still remember it pretty well, I see.

**Sharpe:** Well, yes. I learned a lesson. That's probably why I first considered that the price maybe reflects the knowledge that's out there already.

**Marine-Street:** [00:31:18] Now you said you got some pushback on this article, on some criticism. What did people find fault with?

**Sharpe:** For the formal model, I had to assume that my predictions of the probabilities of different outcomes, or earnings, or of stock prices are the same as yours, that there were some what we call formally homogeneous predictions, if you will. The reviewer, who was not an economist--I guess you would call him a business economist--said, "Well, that's patently untrue. People have different predictions." He hadn't gone the step further--nor had I, explicitly--to say, "Well, the consensus predictions are what determine the price," and then that was not, in those terms, in that paper.

[00:32:40] So he said, "You know, here's a theory built on at least one assumption that's patently untrue," and he came from a different tradition than the economics tradition held by Milton Friedman. Friedman at that time was arguing you don't evaluate a theory on the truth of its assumptions. You evaluate it on the consistency of its predictions or its outcomes, if you will, with reality. You don't question the assumptions. You question the predictions or statements of relationships.

I'd been schooled in that idea, so I wrote back to the then-editor and said, "Look, could you get another reviewer or two? Here's why I think it's worthy of at least another review." Then he changed editors.

**Marine-Street:** [00:33:37] I see. Then after it was published, you had said that some people finally noticed it. Some people thought it was great, and other people were

critical of it. Do you remember any of the kind of debate that was going on once people noticed it?

**Sharpe:** I don't remember the details. I remember John Lintner wrote a piece, a small piece in the *Journal of Finance*, attacking some part of it. I met with John at a meeting, and we had a discussion. John subsequently wrote a paper the next year which did some of the same things.

**Marine-Street:** Interesting. At this point you were at Washington by the time it gets published, right?

**Sharpe:** That's correct.

**Marine-Street:** [00:34:27] So why did you make the decision to go into academia instead of staying in either government or going into industry? It seems like you were very well suited to take a different path.

**Sharpe:** Certainly it was not unhappiness at RAND. Quite the contrary. But no, fairly early on at RAND I remembered that my father went to Golden Gate College, now University, in San Francisco after the war and was in an administrative position. By then he was president of Golden Gate or something. So he was in academics. And as I was growing up, I spent summers with my dad and helped assemble documents at Golden Gate and I thought that was pretty nice. My mother was in education. I'd loved UCLA and graduate school, and I'd pretty well decided I wanted to go to a university. [laughs]

[00:35:35] But I had a master's degree and I thought I could teach at

a junior college. For that I needed a teaching credential, so I took a course given by a professor at the UCLA education school for credit. To get an education credential, you had to take, among other things, a course in audio-visual education, and this was at night, which I don't think bore on the matter. It was the dumbest course I have ever taken. [Marine-Street laughs]

It was just stupid, and I thought, rather than finish this course--and I think I had to take another one to get a teaching credential for junior college--I'd rather take a PhD. [both laugh] I just can't take them. It's not fair to education departments, but I can tell you that particular course from that particular teacher was just terrible. It was sophomoric in the worst sense.

[00:36:39] So that's when I decided to go back and get the PhD, and my plan was to go into academics all along. RAND, as I mentioned, covered part of my tuition, which was not a lot of money, but I think you had to earn it or something. I think I had to pay back a little, because I got the PhD in June and went to Washington in September of that year. So that was my plan, and going to Washington, [laughs] it really seems like I did everything on the spur of the moment.

I actually had a trip to Tacoma for RAND. I was gathering some data at an Air Force base, and it spanned a Friday and a Monday. I spent the weekend there and I drove around Seattle, Lake Washington, Lake Union. I

was a sailor, and I think it was a beautiful spring day and there were sailboats. Seattle at that point had more sailboats per capita than any place in the world, I think. I saw this gorgeous place with all this water and all the sailboats, so I went back and talked to Fred Weston and said, "Fred, can you get me a job at the University of Washington?"

He said, "Yes, I think so."

I said, "What do I have to do?"

He said, "Well, I'll send them a letter."

He sent them a letter, and I think they asked me to send some papers or something, which I did, and then they offered me a job. Again, these were simpler times, and they were expanding. I didn't go on the market in the traditional sense. I just went to Washington.

**Marine-Street:** [00:38:26] Wow, and you found out it rains there a lot.

**Sharpe:** I found out it rained there. I'd been commuting on a motor-scooter [both laugh] when I was at RAND and UCLA, and I found out that wasn't such a good thing at the University of Washington.

**Marine-Street:** So you came on as an assistant professor.

**Sharpe:** I came on as an assistant professor, yes.

**Marine-Street:** What was that like?

**Sharpe:** Well, it was an interesting time, and this is true at Stanford. That was a time when business schools in general and finance in particular were changing from a case method training--you would discuss, "Here are the people at

General Motors and they're trying to decide whether to issue this bond, and they looked at this, and then they did that, and what would you have recommended? What do I want to say?"--rather than what I would call education, to put it pejoratively.

[00:39:34] The University of Washington business school, more or less in general, with some exceptions, had been of that persuasion, and they hired me and two other young guys. They were guys who had come up through business schools rather than economics departments. Again, it was in the air, finance in particular, not so much the other fields. Economics had infiltrated finance, and I was just one of many. Fred Weston before me, and others from University of Chicago in particular were trying to infuse finance with economic theory, hard-headed research, and empiricism.

[00:40:25] So it was an interesting time, and the people at the business school at the University of Washington gave me my hand. They let me teach, and I tried to teach everything I could. I taught statistics. I didn't know anything about statistics. I created two computer courses, a programming course and a computer language course, let's call it. I taught business finance. I didn't know anything about business finance, because the best way to learn anything is to teach it, and they gave me free rein. They were great.

**Marine-Street:** Was it a pretty big university then and big classes?

**Sharpe:** Yes, it was. I can't remember the number, but it was maybe in the

teen-thousands, eighteen thousand or something like that. It was a big university.

**Marine-Street:** [00:41:24] The students were undergrads or master's students?

**Sharpe:** Undergrads, master's, PhDs.

**Marine-Street:** So you had all of them. What else do you remember from that time? Any special challenges about being an assistant professor and adjusting to the academic life after having been at RAND?

**Sharpe:** When I was at RAND, I had actually taught two night classes. I taught Econ I, I think, as a University of California extension course. It was actually in downtown LA, and I taught Econ I at San Fernando State, again a night class. So I had had experience teaching, in addition to having been a TA at UCLA. I had a pretty good sense about teaching.

[00:42:23] Again, I developed the computer, and I gave courses to the faculty teaching them programming. Then I got the business school to set up [a station]. We were at the top of campus in the computer department, and the computer itself in the Computer Center was at the bottom of campus. The dean was very cooperative, and we set up a little station with a keypunch machine and hired part-time students, too, so the faculty members could just write out a program or set up some data. Then the keypunch people in the Center would create all the cards and schlep them down to the computer center, and then go pick up the run and bring it back.

**Marine-Street:** So when you're teaching the faculty the computer programming, they're

basically learning how to write it out longhand first.

**Sharpe:** [00:43:13] Yes, exactly. The business school at U-Dub was fabulous, and as I mentioned, I took a year off and went back to RAND. When I came back they promoted me from assistant to associate very quickly.

At UCLA people would come and give lectures from Chicago. There was a circuit of academics that would give talks at different universities, and there was a sort of an intellectual environment. At that point, at least, the business school was not part of that and going to RAND every summer gave me what I needed. But I had two small kids and it didn't seem sensible to go to RAND every summer and uproot them. One summer I also taught at UC Berkeley's summer program while I was at U-Dub.

**Marine-Street:** Tell me about how you encountered the BASIC computer language [Sharpe laughs] and how you worked to communicate that to your students.

**Sharpe:** [00:44:32] Oh, my nefarious programming days. It's a long story. I had tried [teaching FORTRAN to the students]. I don't know if I tried and failed or just decided I couldn't. It was too fussy a language. You had to be precise in this, and there was a lot of work to do which you really didn't need to do to get a relatively simple job done.

I read about this project at Dartmouth, John Kemeny and Kurtz developing a language called BASIC--Beginner's [All-purpose Symbolic Instruction Code]. In some ways it was like the JOSS language I mentioned at RAND, a very simple language. You could make mistakes, of course, but

it was clearly what would have been perfect for my students, and for that matter, for my faculty at U-Dub.

[00:45:41] But it was being developed at Dartmouth, and they were building compilers which translate from a programming language to a language the machine can understand. They were building compiler programs at Dartmouth for Dartmouth machines, which I think were General Electric. We had an IBM machine and a Burroughs machine at the computer center at Washington, and so, what to do?

I thought, "Well, how hard can it be to write a program that will translate a program written in BASIC to a program written in a language for which there is a compiler already on the computer?" In the case of the IBM, that language was FORTRAN. In the case of the Burroughs, that language was something called ALGOL. So it just showed I had too much time on my hands, I suppose.

[00:46:34] So I wrote a FORTRAN program that would translate a BASIC program into a FORTRAN program and then run it and produce the output, so the user would think the computer knew how to understand BASIC. Then just for the fun of it, I also wrote a program in ALGOL that would translate from BASIC to ALGOL and then run the ALGOL program for the Burroughs machine, partly because there was more time available on the Burroughs.

The FORTRAN version of that was UWBIC (University of

Washington BASIC Interpretive Compiler), which is jargon that describes that process. I don't know if I published it somewhere, but I know some people in Germany used it, [laughs] and we used it for a while. I guess we used it all the time I was there, but at some point BASIC became available for the machines, or there were new machines, and it's now long obsolete. It was a fun project.

**Marine-Street:** [00:47:50] Were you writing the book on the computer language at this time too?

**Sharpe:** Yes. I'm glad you mentioned that. Once I got that working, I thought, "Okay, I'm going to teach a course in which students learn BASIC, but there wasn't a book. They were working on a book at Dartmouth, and how hard could it be to write a simple book for simple programming in BASIC?" So I did, and that was published. Then BASIC started appearing on many computers, so that book actually beat it into print before Kemeny and Kurtz's book.

**Marine-Street:** Oh, boy.

**Sharpe:** [00:48:30] It sold for a while.

**Marine-Street:** Did the students respond pretty well to the course?

**Sharpe:** Yes, they did. I taught that course, and then I developed a course just for fun, which really was fun. I only taught it once or twice and I think the students enjoyed it. I called it Programming Languages, and there were all these programming languages. There was BASIC. There was FORTRAN.

There was a language called COBOL. You mentioned earlier Grace Hopper. I think she was involved. It was a common business-oriented language. There were simulation languages. There were all these languages out there. Now there are thousands.

[00:49:22] I thought it would be fun to build a course around, why do you create a language, and for what uses, and why is this language good for simulation? One of the languages was SIMSCRIPT, which Harry Markowitz developed. In the course I wanted them to understand how you get from a high-level language to the instructions the machine knows how to execute in hardware. So we invented a little language, very, very crude, very, very minimal, and then I had an assembly language machine. It was actually an interpreter, and so we wrote a little program in assembly language to translate statements from the little language we invented. We sort of tried to help them understand the process that goes on in facilitating a language.

Then I think we looked at SIMSCRIPT for simulation, COBOL for business, FORTRAN for science, and maybe one other language--I can't remember what--to get a sense of how different some of these languages are, and the whole role of a specialized language in facilitating work in a particular field. That was a lot of fun, and the students liked it. I had a great time.

**Marine-Street:** [00:50:56] Yes, it sounds brilliant. Give them a peek under the hood at what happens that they can't see. So Harry Markowitz developed a computer

language?

**Sharpe:** He sure did. Harry had been at Chicago at a research center, I think actually in New York. Then he'd been at GE, I believe. Then he came to RAND. Harry would tell you to this day that he's really more a mathematician than an economist, although his PhD is in economics,. He is of course both.

[00:51:38] He became very interested in simulation, and he developed an entire language. It's more than just a language. It's a whole way of looking at the world if you're going to try to simulate processes, and many of the constructs he developed are very similar to what now is widespread object-oriented programming. He used different terms, and there are different arrangements.

So he sort of invented the language. Again, I'd had all this before I went to Washington, which is one of the reasons I knew something about this. Then he and some people in the computer department built the compilers and interpreters to make it feasible to run programs written in this language on, in that case, the IBM mainframes.

We call the language SIMSCRIPT, Simulation Scripts, and at some point he and Herb and one other left RAND and set up a company. Then that went through various travails and drifted off to other formats.

**Marine-Street:** [00:53:03] Oh, that's interesting. I wasn't aware of this sort of economics at the birth of computer science, and programming.

**Sharpe:** Well, it was sort of economics, operations research, and computation. At

RAND, you could go to a seminar in anything, and if you wanted to learn something about computer simulation you could go to a seminar. It was just this amazing intellectual environment.

**Marine-Street:** Yes, it sounds really great. Let's take a break.

**Sharpe:** Okay.

**S T A N F O R D U N I V E R S I T Y**

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|---|---|
| PROJECT: | STANFORD FACULTY ORAL HISTORY PROJECT |
| INTERVIEWEE: | WILLIAM F. SHARPE |
| INTERVIEWER: | NATALIE MARINE-STREET |
| DATE OF INTERVIEW: | AUGUST 22, 2018 |
| PART: | 3 OF 4 |

**Marine-Street:** We're resuming our interview with William Sharpe, and before we get to Stanford, I wanted to ask you, in 1968 you decide to make a move from the University of Washington. Could you tell me what led to that decision and what you did next?

**Sharpe:** Yes. I went to the University of California at Irvine, where Jim March was establishing--or had established and was in the process of continuing--a school of social sciences that I suppose was designed to be different from any other school of social sciences or equivalent in the world.

[00:00:46] Some friends and I went to it in senior positions, full professors, and there were all kinds of experimental things: no departments, and some of the professors lived with students in trailers in a little farming area near the campus. Jim really wanted to break free of boundaries, and in particular, he wanted to break free of doctrinal boundaries. So economists, sociologists, and political scientists would all work together and there would

be no boundaries.

It was an interesting and, I thought at the time, heady prospect. One of my good friends went in economics. One of my undergraduate friends went as a full professor in political science, and then we had a lot of young faculty. But at least on my terms and I think ultimately Jim's terms, it didn't work out.

[00:02:00] After the first year, year-and-a-half, I decided I needed to be somewhere different and somewhere more traditional, so I contacted Stanford. I had interviewed at Stanford before I went to Irvine and decided not to follow it up. I asked them if they were still interested, and they were, and so I came to Stanford, as did Jim March, shortly thereafter.

**Marine-Street:** Yes, that's right. Do you know if they then closed down that experimental school after Jim March left?

**Sharpe:** I have not followed it, but I think it still exists. I don't know whether it's become more departmentalized and traditional. I just haven't followed it.

**Marine-Street:** [00:02:52] Was part of the problem the 1960s era and the protests?

**Sharpe:** Well, that was certainly in the background--student protests certainly--but I don't think that really played a major role. Obviously, as a school of social sciences, we were heavily involved, but I don't think that really was a large part of it. There was and still is an economics group--I don't know if it's a department or in the business school. They have a business school which I think maybe doesn't have a business school title, but they did then and do

now. But this was a different creature. It didn't work out for me, and it didn't work out for actually quite a few. Both of my friends left.

**Marine-Street:** Interesting chapter in the history of higher education. It sounds like a road not taken. Tell me a little bit about the hiring process at Stanford, who you connected with, and that kind of thing.

**Sharpe:** I can only speak of the time I was here on faculty, so I can't tell you much about what it is now and has been for many years.

**Marine-Street:** Yes, just when you got hired, what was that like?

**Sharpe:** When I was hired, certainly, the business school was pretty much an entity unto itself, and it did not have departments as such. We called them areas. There was the finance area, and the economics area, *et cetera*.

[00:04:27] I went to the finance area, and there would be an area coordinator, but the areas didn't have budgets *per se*. They in effect negotiated with the dean's office to get positions they could fill, and then the areas would pretty much do the recruiting, do the vetting, and then with I guess approval of the dean's office, make offers. There was the finance area that was interested in me, and I was interested in them, so that process played its role, and I came to Stanford.

**Marine-Street:** What was Stanford's reputation at the time in the business school?

**Sharpe:** Stanford's reputation was very high indeed. I don't know exactly. I can't remember, but on the usual metrics of articles in major journals, Stanford was one of the premier finance areas--informal. [laughs]

**Marine-Street:** Were they known for any particular approach, or were there people here that had made a big splash in terms of finance?

**Sharpe:** [00:05:45] The finance group was in a transitional phase Let me give you a slightly bigger picture. At some point in the 1960s, and I can't remember exactly when, the Ford Foundation created a group and did a major, major study on business schools. The basic conclusion was that business schools needed to have more of a theoretical, academic underpinning and be less experiential, I suppose you would say. The Ford Foundation report pushed very hard in that direction, and they gave grants of substantial amounts to various business schools.

One of the people who was involved in that study was Jim Howe, and in 1970, when I approached Stanford, Ernie Arbuckle was dean of the business school and Jim was the associate dean. They collectively were on a mission, you might say, to do some of the things the Ford Foundation had recommended.

[00:07:05] I can speak mainly for finance, and I think in the other areas as well. They were searching for people to come who were more theory-based, were more in the academic mode, research mode. That was certainly true in the finance group. There were a number of us that came in that year, one year before or one year after, to change the focus of a lot of the finance courses, as well as the research, in our own research, at least.

A number of the faculty were in that mode already, Alex Robichek in

finance was key among them. Some were not, but the new hires continued to come--Paul Kutner and Myron Scholes. The two that I worked most closely with were Bob Litzenberger and Alan Kraus, and the three of us built the PhD seminar, which didn't exist. There were PhDs being granted in finance, but they mainly took MBA courses and courses "across the street" in economics and other fields.

[00:08:32] We created a three-quarter PhD course which we jointly taught for a couple of years and then singly. We also created a faculty seminar series with faculty in finance at Berkeley, in which we would have a seminar with one of us or a visiting speaker and then would all go to dinner. We alternated between the campuses because there weren't that many of us that had that focus at either institution.

So that was a very big deal. Some would call it quantitative finance, but that I think doesn't capture it very well. It was sort of theory-based empiricism, more in an academic research tradition rather than experience, although most of the faculty did some things as consultants and had real experience themselves in the real world, as it were.

**Marine-Street:** [00:09:41] Now did they have a name for you--kind of young Turks--and the approach that you were using?

**Sharpe:** I liked the name "financial economists." That was the name that was beginning to come into vogue, but I don't know if any of my colleagues would have attached that name to themselves.

**Marine-Street:** Can you tell me a little bit about the culture of the GSB and the finance area in particular?

**Sharpe:** Well, the culture of the school as a whole was going through this transition to become more theory-based, more research-based, more journal article-based, if you will, rather than case method, although some still use the case method. I think under Ernie and Jim, and then certainly under R.J. Miller. R.J.'s term for it, which I always liked, was "balanced excellence." We're going to be excellent in teaching, and we're going to be excellent in research. I think the school was in some sense moving in that direction, but it didn't take long before it was balanced excellence pretty well throughout.

**Marine-Street:** [00:11:03] Did you have faculty meetings or all-school meetings?

**Sharpe:** Again, I can't speak for what it is today, but in my era there was a faculty advisory board which was all the tenured faculty in the school, basically associate and full-time professors. That group had a vote, but in principle it was a recommendation to the dean, who could then recommend to the provost. Basically that group had to vote on promotions and new appointments.

**Marine-Street:** The whole group?

**Sharpe:** [00:11:49] The whole group. So while the area faculty could pretty much do the selection of hires, new hires had to be approved by the faculty advisory board. When it came to promotions, especially to tenure, then the whole faculty advisory board was involved. I think in most cases, there was

deference to the faculty in the area in question, but there were some good, serious academic fights over the years.

**Marine-Street:** Was there jockeying for, "Well, if we let finance hire that guy, then we're not going to be able to have our person come on?"

**Sharpe:** In a word, yes. There were associate deans, initially only one, but then over the course of time they multiplied. There would be an associate dean, somewhere in the dean hierarchy, in charge of, say, three areas. You had to sort of jockey with your dean or associate dean for money among that group, and then that would go on. As they say, the reason academic fights are so vigorous is because the stakes are so low. [both laugh]

**Marine-Street:** [00:13:28] Boy, that's good. [laughs]

**Sharpe:** But it wasn't a formalized. I don't ever recall sitting in the faculty advisory board with a budget for the school in front of me, so it wasn't, "Well, if we spend this much money on a full professor for this area, we won't be able to spend this much on two assistants over here." At least at the level of faculty. I was an area coordinator for finance for several years, which meant I was in charge of the recruiting process and not much else.

**Marine-Street:** [00:14:07] Was that a big job to be the area coordinator?

**Sharpe:** No, no. That's one of the big differences between the other schools I've been at, and I think other departments within Stanford. In many schools, you are on so many committees it just drives you crazy. That was certainly true at Washington. I was on committees within the school, committees

outside the school, Computer Center, what have you. In the business school, you're on almost no committees, which by my lights was just fine [both laugh] because it gave you time for your teaching and research.

**Marine-Street:** [00:14:52] You were tenured, so they can't get rid of you too easily, but were there metrics that you were judged by or the area was judged by?

**Sharpe:** Oh, yes. There were numbers collected and distributed across the school relating to number of journal publications. The details changed from year to year, but there were definitely metrics, and publication in reputable journals was one of the key ones.

**Marine-Street:** What about number of students or the students that enrolled in your classes? Was that a concern about enrollments or number of PhD students?

**Sharpe:** [00:15:35] Well, that changed. The first few years I was there, there wasn't a lot of concern, and they even had this wonderful tradition. You could create a research seminar. I can't remember what they called it. I did one two or three years in a row on public pensions, or pensions in general. In any event, you'd create a description, and the rules were, as long as you got six or more students to enroll, you could do it. You could do one of those every year, and there were even cases in which they allowed one of my colleagues to do it when he only got three students enrolled.

Those were marvelous, because you could take an area of your research interest, build a seminar around it, and some of my most satisfying teaching at the business school was a couple of those seminar series. I don't

think they do that anymore.

[00:16:41] As far as regular courses, there were very few given in the auditorium, but otherwise you were limited by classroom size, so it would be thirty, forty, max.

**Marine-Street:** So not too big. Did the business school have much interaction with other parts of the university?

**Sharpe:** Remarkably little in my day. I did interact with the Economics Department, and I think twice I taught courses in the economics curriculum because I really wanted to. But no, it was pretty insular.

**Marine-Street:** What about with anybody that was over at the Hoover? I know we had some pretty interesting economists come through there.

**Sharpe:** [00:17:31] There was more contact with Hoover, especially in the latter part of my tenure, just because George Shultz was there and some other personalities. There was I would say a little more, but not a lot of contact between the school and other departments in general.

**Marine-Street:** You mentioned Jim Howe, and Ernie Arbuckle, and R.J. Miller. How accessible were the deans and the associate deans?

**Sharpe:** The associate deans were very accessible, and they were, with one or two exceptions, just absolutely crucial to making the school what it was. So they were very accessible. The deans, it was kind of a president-provost model--at least, that's what it seemed to me--where the associate deans really dealt with the academic side and the dean was, to a major extent, a

fundraiser.

**Marine-Street:** More outside-facing.

**Sharpe:** And also a negotiator with central campus because there was a perennial problem that the business school alumni gave more money than the history alumni, let's say, for at least some reasons we can imagine. [Marine-Street laughs] So there was always an issue, and I know R.J. negotiated with central campus to at least get a five-year budget, five years at a time, from the campus so at least he could make plans. Those negotiations I guess were pretty difficult sometimes.

**Marine-Street:** So you're saying that the GSB alumni would make charitable donations to the university as a whole?

**Sharpe:** [00:19:27] I don't know enough about the inner workings, but I think there was some desire that the business school not get all the donations from business school alumni and businesspeople, that somehow or other, something be worked out so that some of that money would get to the other parts of the campus, which everybody was comfortable with. I think R.J.'s feeling, as I recall, when he came in was, "I need some visibility on what I'm going to have in the next three or four years," so he negotiated for some sort of an agreement with central campus to give him some planning room.

**Marine-Street:** What was R.J. Miller like?

**Sharpe:** Oh, wonderful, a wonderful human being, just straightforward, no fooling

around, a great human being. You could almost see a twinkle in his eye. I can't imagine anybody not really loving R.J. Miller.

**Marine-Street:** Was he a great motivator?

**Sharpe:** [00:20:42] I would say so, yes.

**Marine-Street:** Interesting. How about the students that came to the GSB during those years?

**Sharpe:** Well, [laughs] my father knew quite a bit about Stanford because he either was taking or had taken the PhD in the education school, and he knew about the business school, too, from his Golden Gate contacts. [When I was considering going to Stanford], he said, "Well, you understand that even if for two years all you taught the MBAs at Stanford was nonsense syllables, they would still be captains of industry." Or my economist's version of the tale: "The value added was in the admissions office."

**Marine-Street:** Interesting.

**Sharpe:** [00:21:39] The students were just brilliant. They of course had a diverse range of interests and backgrounds. In some ways, a couple of those seminars I mentioned were highlights for me. Another couple of highlights: we had a microeconomics course which was a pretty serious theory course, and it was required in the MBA curriculum, at least for a number of years. The students who came in with some economics in undergrad, or math and physics, didn't have much problem with it, but some of the ones that came with a very strong liberal arts background did.

So we set up a couple of sections, I think one a year, and I taught it for two years, I believe, which we called informally "the poets section." It was for students who were poets and not mathematicians, and that was one of the greatest experiences of my life. They were all so bright. I could teach it *de novo*, and I believe that they learned just as much serious microeconomic theory as students in the other sections.

[00:23:11] It might have been a Hawthorne effect that made them think it was good because they knew it was a special experiment, but I still get letters from some people who say, "Look, I was in your microeconomics class in the poets section, and I've done this, and I still use this every day." So that was a wonderful experience.

**Marine-Street:** That does seem like it would be neat to get a chance to introduce a field that you were passionate about to people that were very bright but hadn't had a lot of experience.

**Sharpe:** In that course, I tried to take something out of the newspaper within the last week for each class, that I could use to illustrate whatever piece of theory we were going to do that day. So I definitely taught microeconomic theory, but I tried to teach it in the context of some current issue or problem, and it was a lot of fun.

**Marine-Street:** [00:24:11] Do you have any moments that you remember, any ah-ha moments that the class would experience, or any favorite examples that you liked to teach in that course?

**Sharpe:** Oh, boy. It's a long time ago, and again, I didn't really do a syllabus or anything. I should mention this seminar, though. I can't remember what we called them, but one year in particular, the important legislation, ERISA (Employee Retirement Income Security Act) had just been passed, regulating defined benefit pension plans, traditional pension plans where you work, you retire, they pay you, you die, your partner or spouse gets checks, they die, the checks stop--the old-fashioned way of doing pensions.

[00:25:13] There'd been a lot of scandals in the area, so Congress passed in whatever year it was--I'm thinking 1966, but I'm not sure--an act to really tighten up on regulations, funding, reporting, what have you. One quarter we did a whole seminar on that, and then one quarter, the next year I guess it was, we formed an investment group and everybody chose a position. I was the computer department, [laughs] and I brought my mini-computer from home into my office so I could do programs and data processing for them.

[00:26:02] In those two years, I had some absolutely amazing students, and a number of them went into the financial industry, investment industry in particular. This last spring, one of the members of one of those groups had donated money--Doyle Arnold is his name--to Rice, his undergraduate alma mater, to establish a series of lectures by Nobel economists, and I was invited to do it. Then three of the other students who were in that group that he was in came also for the lecture, and we had

lunch and a few things.

**Marine-Street:** Oh, neat.

**Sharpe:** So that group sort of re-formed, at least a corpus of them--all but one. One of them went into manufacturing. But Doyle and two of the others [went into investments]. So they were part of that group, and I've kept in touch with some of the others as well. That was really a highlight. Unfortunately, I don't think they do that anymore. They may again. I don't know.

**Marine-Street:** [00:27:21] You taught an investments course as well, right?

**Sharpe:** Yes, I taught a course--it wasn't a required course; it was an elective--in investments, and in the process over the years, wrote a textbook on MBA-level investments, if you want to call it that. It was pretty different from the extant textbooks. I didn't use textbooks when I taught the course. I used journal articles, and handouts.

Fortunately, the investments textbook caught on, and I think other textbooks published after it followed some of the ideas. The current textbooks are much more theoretical and academic than were the textbooks that were in use when I published that book.

**Marine-Street:** [00:28:22] Oh, interesting.

**Sharpe:** The downside is that the first year after the book was published that was the textbook for the course. Before that I would use little handouts, and other articles, and what have you, but when the book was published, my ratings dropped, not precipitously, but they dropped. The typical comment was,

"Well, you just teach us out of the book," and so what are you going to do?

**Marine-Street:** How was the process of the evolution of that textbook? Did you have to update it often?

**Sharpe:** After it was published, oh, yes, and the investment world keeps changing. People keep trying new things, new products, new services, new instruments, and also the graph of the ups and downs of the stock market. People want it to be up to date, and it was a big book. It was seven hundred pages, so revising it was just a terribly hard undertaking, and really boring.

[00:29:35] I made it through the first three editions by myself and then brought on a co-author, an academic. Then he was suffering the same angst I was after a couple of editions, so we brought on a really smart guy from the industry. But after the seventh edition, I think it was, we also did a simpler version that you could use in a junior college course, so we had two books going. Then finally, when it came time for the eighth, we all said, "We don't want to do this alone anymore." The publisher couldn't find anybody, and we couldn't find anybody, so we declared a victory.

**Marine-Street:** Interesting. Are there any other courses that you'd like to talk about that were memorable? I know you taught some things on corporate finance.

**Sharpe:** [00:30:34] Well, yes, the corporate finance, I taught it once. We had a required corporate finance course, and I and a number of my colleagues thought it should have had more theory. It had quite a bit, but it should have had more. One of my dearest friends, who was the leading faculty

member in corporate finance and had his own textbook, felt that the course should stay the way it was.

It was within the finance area we had these debates, and at one point I said, "Look, let me teach a section the way I think it ought to be, and so at least I know something about what I'm talking about."

[00:31:24] So I did, and I taught it the way I thought it should be taught. I think it went well enough, but there was certainly no love feast between me and the students. Finally, as a group, we did change the curriculum of the course a bit in the direction that I and some of the others were advocating. It was a compromise, and I think a good one.

**Marine-Street:** Was it to be more theoretical?

**Sharpe:** More theoretical, yes.

**Marine-Street:** We've talked a lot about things being more theoretical or adding more theory. How do you understand theory, or what does it mean that something's more theoretical?

**Sharpe:** [00:32:10] Oh, boy. Obviously it's a very vague term, [laughs] so I can't describe it, but I can illustrate it, perhaps. Let's take the corporate finance context. By issuing stock there are all kinds of things that happen after the initial issuance: repurchases, new issues, different tranches of bonds, whatever. If you approach that set of decisions, you approach it with a lot of institutional material: here's what General Motors does, here's what Ford does, here's what happened here, here's the bankruptcy law.

Or do you try to build a framework? Imagine a world in which there's uncertainty, and let's say there are *n* different possible scenarios as to what could happen to interest rates or to such-and-so. Then you do a model, which is to say, a caricature of the actual problem that you're looking at, and then say, "What would be optimal, maximizing *x*, where *x* is some function having to do with market value or what have you?"

[00:33:48] Then see what the math or the computer program tells you should be done in that idealized, simplistic context and use that to address an actual problem that you could be confronted with. That's a very dry explanation of the difference.

**Marine-Street:** Is being able to make a model pretty key?

**Sharpe:** Yes, I think that's a good term. I think you make a model. Call it a theory. Call it a model. You could call it these days a computer program.

**Marine-Street:** Are you a pretty visual person? Could you imagine it?

**Sharpe:** I'm very visual, and yes, whatever we're talking about, I draw graphs in my head, demand curves, supply curves, and difference curves, things of that sort. That's because that was the mode for microeconomics when I was studying it. After that, it became very mathematical, with math that's way above my grade.

**Marine-Street:** [00:35:03] Yes, I've heard a lot of people say that the math has gotten very complex.

**Sharpe:** Well, I topped out at a junior college course in differential calculus. [laughs]

**Marine-Street:** But got pretty far with being able to visualize things in your head, I'd say.

**Sharpe:** Yes, I faked my way through. [Marine-Street laughs]

**Marine-Street:** I know that consulting was always a part of GSB professors' work. Could you tell me a little bit about what role consulting played in the life of a professor, and then maybe you could give me some examples of some of the consulting that you did.

**Sharpe:** [00:35:41] Well, consulting obviously pays money, and nobody should pretend that that isn't part of it. But consulting allows you to learn more about the domain you're trying to understand, research and teach, and it also allows you to try out some of the ideas, theories, and techniques that you have. I've always tried, without always complete success, to keep a foot in each camp. You can bring information from the academy to the real world, and you can bring information from the real world to the academy. Especially in a field like finance--I won't speak for all of business, but finance--I think that's extremely important.

[00:36:38] Obviously at RAND, I was in both camps, and at the University of Washington, early on I began to consult with Merrill Lynch in New York on investment models and performance analysis. That was very fruitful for me, and I think they thought it was for them. When I was at Irvine I was still consulting for Merrill Lynch, and then I did some things for Western Airlines, building some computer models of some of their issues.

Over the course of years when I was at Stanford I consulted extensively with Wells Fargo. I took a sabbatical leave at one point and did any of a number of things. I tried to really understand what was going on in the investment industry, tried to bring some of the academic ideas to them, and tried to test some ideas with them and bring information that I'd learned there back into the classroom. I think it was very fruitful all around.

**Marine-Street:** Yes, it sounds like it would be really important for a business professor to be doing that kind of consulting.

**Sharpe:** [00:38:08] You can call it field research. When you have a menu of possible consulting engagements, as I sometimes did, you have to consider both the money and what you will learn and teach. I tried not to let the money weigh too heavily in those tradeoffs.

**Marine-Street:** So making sure that you were choosing assignments that would forward your [teaching and research].

**Sharpe:** That would inform my teaching and allow me to test some of the ideas that I was developing in research.

**Marine-Street:** Was there much effort of the school or the university to try to regulate the rules of consulting for professors?

**Sharpe:** [00:38:55] I would say generally not. I think there may have been some university rule about number of hours, but I don't recall ever having a reporting requirement. There may be one now and there may be a university requirement now, because obviously there's a balance point. I tried never to

let it diminish the effort I was putting into the classroom. But again, it's a tradeoff.

**Marine-Street:** What was going on at Wells Fargo when you were doing the consulting?

**Sharpe:** Oh, that's an interesting story. There was an industry group called the Institute for Quantitative Research in Finance. It just celebrated its fiftieth anniversary last year, and I gave a paper there. I think it was their second annual meeting. They now do two a year.

That one was at Princeton, I think, and I became very involved with that group. They let me come to meetings even if I wasn't on the program, and I gave many papers, presentations, because these were sort of initially the people at the vanguard of quantitative methods being applied in investments. This is investments, not corporate finance.

[00:40:31] I was very involved in that group, and when it came to Stanford, I think through that group I had known two people--one very close, Mac McKeown, who was head of a a quantitative research group; and Bill Fauss, who was head of the investment department at Wells. I remember in one of my first investment classes asking Bill to talk to the class about what they were doing. This is after institutional index funds were first really made popular in the institutional world, and so basically this was the hotbed of modern quantitative investment management.

[00:41:28] I remember I had a call from a chap. He'd just got an MBA from the University of Chicago, and I think he was the son of the

owner or founder of Samsonite, the luggage company. He said, "In our course we were taught your model and why a broad index fund would be …" I don't know that we called it index funds then, but a broad, market-based fund would be a good thing.

I put him in touch with Bill Fauss, and out of that came the first institutional index fund. Then at some point Bill asked me if I wanted to do consulting for them, which I did over a number of years. That was for me extremely fruitful. I think for my students it was extremely fruitful. I hope it was extremely fruitful for Wells Fargo.

**Marine-Street:** [00:42:22] What kind of problems were they encountering as they tried to implement an index? What were the challenges of being able to do that?

**Sharpe:** There were issues as to the construction of the index fund. One, some people thought you should just put equal dollars in each stock and in an index. There was also the question, which index? Then the theory said no, you should put dollars in the stock. You should have basically equal percentages of each stock--0.1 percent of this stock, 0.1 percent of that, *et cetera*. That's what the capital asset pricing model would tell you.

Then there was the question of how often should you turn it over to deal with new issues, redemptions, what have you, buybacks. So there were a lot of practical issues which were good, fun, empirical issues to deal with, and there were any of a number of those issues.

[00:43:32] Then there came a point at which there was some

academic research--some of it by Bob Litzenberger, one of my colleagues, and Krishna Ramaswamy, one of our PhD students--that suggested it might well be that since some investors pay differential taxes on dividends and capital gains, and others like pension funds and endowments don't, that the overall market equilibrium might be such that the before income tax return on stocks that paid more money out in dividends than they realized in capital gains might be better investments for the institutions and somewhat inferior than for the individuals. So it's a more complicated equilibrium model.

So I and others, including Bob, worked on that from a theoretical standpoint. Then I helped Wells implement such a fund [laughs] which came to market, and some people invested in it. Interest rates then [laughs] went up and the debit high-yield stocks fell like a tank. Within a relatively short period of time all that money was gone.

[00:44:57] It didn't go bankrupt, but people pulled their money out of the fund, so that fund died a somewhat unseemly death because it couldn't last through that period to the longer-term results. We did a number of studies, very, very smart people in that group. It's interesting. I'm going to Bill Fauss's ninetieth birthday party next month.

**Marine-Street:** Is that right? Interesting.

**Sharpe:** I still keep in touch with some of the people that were there.

**Marine-Street:** Any other memorable consulting engagements? I know you did a lot of

work with different pension firms.

**Sharpe:** [00:45:39] Well, yes. That was in a somewhat different mode. In 1986, I had a number of research agenda items. I had become interested in public pension funds and in university and other endowments way back. That was the focus, as I mentioned, of one of my small seminars, and I had done papers on endowment investments in pension funds back into the 1980s.

I was really interested in pursuing some problems sort of generically: you are the person on the staff of General Motors in charge of the General Motors pension fund, or you're the person at Stanford in charge of the Stanford endowment. What should you do? How should you invest? On what basis? What information should you use? What should you measure? All are the issues of the person on staff, managing, at least first-hand, the pension or endowment fund. Obviously it's different for an endowment and a pension because a pension has liabilities and an endowment just has an amorphous set of needs.

[00:47:01] There were some things, some models and some empirical results I thought I could get, but I needed resources and time. Ultimately, after considering other alternatives, I worked out an arrangement with a firm based in the state of Washington, the Frank Russell Company, which was a consultant for General Motors, IBM, the state of Oregon pension fund, *et cetera*. They funded and helped me get some of their clients to act as clients, if you will, for a little firm called Sharpe--at that point Sharpe-Russell

Research. This was in 1986, so I took a two-year leave from Stanford.

[00:47:48] My wife was the administrator, and then we hired some research people. It was a small firm, and we did two major studies, one for a major mutual life insurance in Japan and one for Nikko Securities in Japan, where we got Japanese data and did a lot of analyses of Japanese market-built software systems. It was quite an undertaking, but our staff I think peaked at seven. I came up with some new techniques and approaches that seemed to have caught on, with something called returns-based style analysis being one of them.

We were actually processing detailed data every month for the IBM pension fund, the General Motors pension fund, and working closely with them, so I learned a huge amount. I learned what problems they had that might be amenable to research and new technology and such.

[00:48:58] Then after two years that morphed into a standalone company, and I brought in somebody that I thought could run it. I went back to Stanford for a year, and it just did not work. So I retired from Stanford, went back to the company, and then in 1990, or 1991, I decided I really wanted to be back at Stanford. I went back to Stanford on regular faculty and sort of weaned the clients--we had seven or eight left--and narrowed that down. I eventually kept doing it on my own, and then just by myself, and then rolled it into another company which I helped start in 1996.

**Marine-Street:** What are the pros of doing your own company like that, and what are the cons?

**Sharpe:** [00:50:06] Well, you can concentrate, and you're not teaching in any traditional sense. We had seminars, three-day seminars each year for our clients. There was a lot of what looked like teaching, but you're working with them. You've got the data on a daily basis. We actually ran a little piece of the AT&T fund with special funds from Wells Fargo, so you're in this intermediate position where you're closer to the patient than you would be if you were an academic or even a part-time consultant.

Again, it was a big issue. Most of these funds would have their money scattered. They'd have so much money with Manager A and this much with Manager B, and the question is, how do you hire those managers? What specialties do you use? How do you allocate among them? How do you measure their performance? How do you decide whether to give them more money or take it away?

[00:51:21] There are all these decisions, and in that position we had to look at all of them. It's not like in academia. You can say, "Let me see. I think I can build a nice theory for this one, or I can get a nice empirical result for that one." We had to look at them all, and among other things, we had to develop a new set of statistical approaches that turned out to be very fruitful, almost dumb luck, I suppose, but called returns-based style analysis.

**Marine-Street:** It sounds like what you're saying is that it was more that people had their

relationships with these different fund managers, but the fund managers weren't specializing in different asset classes at that time.

**Sharpe:** [00:52:03] Oh, no, they were highly specialized, and the question is, "All right, you're General Motors. How much money do you put in growth stocks and how much do you put with Natalie, who does growth stocks but has a procedure where she really looks at price-earnings ratios, as opposed to Bill over here, who does growth stocks but actually looks at dividend yield? How do you even define what a growth stock is, and how do you decide how much? Where the boundaries?"

You've got AT&T at one point, or CalPERS at one point had ninety-seven different funds within their portfolio, and how do you allocate among those. How do you measure whether or not Natalie's doing what you want, what you need her to do with her specialty, as opposed to Bill?

[00:52:59] For an academic they're great, juicy problems, but they're really hard problems, and we didn't have the luxury of just dealing with one or two of them because our charge that we created for ourselves was to try to provide quantitative techniques, measurements, optimization, what have you, that could help with the person who is not investing the money but investing with people who do invest the money.

**Marine-Street:** Was the style analysis on a stock, or was it on a manager?

**Sharpe:** It was on a manager. The first problem we faced was, you've got forty managers. Each of the managers has fifty, a hundred, two hundred, five

hundred, six hundred stocks or bonds, because we had to deal with all the investments. How do you figure out how to choreograph this whole thing?

[00:54:05] There was no way that we could go see exactly what stocks are in Natalie's portfolio and how many shares. That was hopeless. So we had to come up with some other procedure, and the natural way from statistics and other kinds of analyses would be to pick some factors, and the first question was, "What factors?" So we had to experiment and create different factor portfolios, but pick factors like small growth stocks, large value stocks, whatever, somehow defined.

You had to figure out how to define, how to categorize, how to measure, and get somebody to do the measurement for you if there weren't indices available. We worked with Wells Fargo and with what was called Barra then, an analytic firm, developing some of the indices.

[00:55:05] Then the question is, "How do you figure out whether Natalie's portfolio is really a small growth portfolio, or a small growth and a small value but it's like the proportions were sixty-forty?" The natural thing was this huge statistical analysis problem, big regression analysis, multiple regression, zillions of variables.

We managed to get the data returns, monthly returns back five years from several of our institutions. We ran those analyses and it just produced garbage. It said, "Oh, well, her portfolio is as if it's 180 percent invested in small growth and minus-thirty in small value," which we knew it wasn't

because you didn't have any short positions. All your positions were long.

[00:56:05] So what are we going to do? I said, "Well, it seems to me the obvious thing is since we know most of these managers don't hold negative positions in stocks, just say, "When you do the statistical analysis, you have to tell it, 'No negative positions, please--negative exposures,' which turns it from a statistical problem to a huge linear programming problem." Actually, it's a quadratic programming problem, but I knew how to solve quadratic programming problems, and by then, big ones.

We tried that, and it was like magic--it revealed truth. I remember we used to do blindfold tests. Show people the results of an analysis and ask them which fund it was. It just turned out to be, for whatever reason, a very, very fruitful approach. So we integrated it, built software, and a regular monthly reporting system. We published articles on it, so it's all in the public domain, and there have been other companies that have developed it and sold it. It's I think pretty widely used, but I'm not on top of it anymore. We did some other things, but that was probably the most notable.

**Marine-Street:** [00:57:32] Then did you come up with the style categories? Was that something you invented, or were they in existence?

**Sharpe:** We did it in cooperation with Wells and Barra. Barra had all the individual stock returns over many, many years, and we also did a model for Japan because we had the two Japanese clients. We took all the data of the returns on individual stocks and bonds and then tested different combinations, but

the combinations were done mostly by Barra.

Some of them, jointly we said, "I know you've got a group of stocks you call value stocks. Could you divide that between small value stocks and large value stocks so we could see whether or not statistically you get more information than noise by using that distinction rather than just have one category?"

[00:58:41] We sorted initially between bonds, stocks, and cash equivalents, something like seventeen or eighteen categories, and it turned out to be quite robust. Again, we had, at the peak, nine clients in each. Probably on average the client would have maybe thirty or forty managers, so we had a lot of data and we spun a lot of computer disks until we got good results. We tested everything out of sample, so it wasn't just, "This worked fine on the data we used to create it, and then all of our ongoing analysis was always done out of sample, so we were clean."

**Marine-Street:** [00:59:34] How interesting. Now what did you do for computing power?

**Sharpe:** Oh, boy. We found somebody in Silicon Valley who was making mini-computers. By that time, I had bought one of the first IBM PCs, and I had had a digital equipment mini-computer before that. From him we were able to buy ten micro-computers, you would call it today, roughly the equivalent of the IBM PC. We basically did everything on that platform. We upgraded them over the course of the years, but always we were micro-computer-based, and we used a lot of software. To my wife's dismay,

trying to administer the company, I kept changing software or writing new software, and I had some very, very talented people on staff, very talented.

**Marine-Street:** [01:00:55] A lot of ex-Stanford people?

**Sharpe:** Yes, all but one, I think.

**Marine-Street:** Oh, interesting.

**Sharpe:** Then we had people from Nikko in our office for a year-and-a-half, and they were very, very smart and talented, so they did a lot of the work on the Japanese model and database.

**Marine-Street:** It's interesting to me that all of these happenings in finance are happening here on the West Coast when so much is centered in New York. Was there something special about being out here in the Silicon Valley that allowed you to do things differently, or didn't it matter?

**Sharpe:** That's a hard question. In terms of the research, there was first-rate research, both in theory and in empirical work being done at MIT, Wharton School, Chicago, Stanford. I would say those are the ones that would leap to mind, and there were plenty of academic conferences. We would invite each other to give lectures.

[01:02:20] So a lot was happening in a number of places. We certainly didn't have a monopoly, but it did turn out that Wells was one of the earliest innovators in the quantitative investing domain. But Merrill Lynch and their consulting arm, which is the one I worked with, we did some of the earliest quantitative performance analysis, so we didn't have a monopoly.

**Marine-Street:** Let's take a quick break.

**Sharpe:** Okay.

**S T A N F O R D U N I V E R S I T Y**

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|---|---|
| PROJECT: | STANFORD FACULTY ORAL HISTORY PROJECT |
| INTERVIEWEE: | WILLIAM F. SHARPE |
| INTERVIEWER: | NATALIE MARINE-STREET |
| DATE OF INTERVIEW: | AUGUST 22, 2018 |
| PART: | 4 OF 4 |

**Marine-Street:** I haven't asked you yet about something that your name is very well attached to, which is the Sharpe ratio for investment performance analysis. Could you tell me a little bit about what the Sharpe ratio is?

**Sharpe:** The Sharpe ratio is really simple. [laughs] In the pure form, it's just averaging, say, over monthly returns--on average, how well you did relative to, say, short-term treasury bills. How much reward you earned on average, that's the numerator of the fraction, and then the denominator is a measure of how much those excess returns varied from period to period, the so-called standard deviation. I called it the reward-to-variability ratio, but others called it the Sharpe ratio. That name seems to have stuck.

[00:01:01] There are other variants of it, but the basic argument is, for a portfolio, if you had to choose between different portfolios, simple theory--and it's really simple--would say if you only care about mean and standard deviation of return, then you should pick the one *ex ante* with the

highest Sharpe ratio if you can borrow and lend money as well. It comes out of my earliest paper, and it's very simple. My general argument is, you don't have to summarize everything in one number. We have computers now. [laughs] You can do much more sophisticated things.

[00:01:51] But if you're going to have one number, at least it takes into account, on average, how is it done and how much variability there has been. Then there's an argument going forward that you can trail off on that. But it's a very simple measure. It seems to have caught on, and it's being applied in areas that it wasn't intended to be applied to. By itself it is not really intended to be applied to a piece of a portfolio like your growth stocks. Then there are variants of it that could be more applicable for a piece of the portfolio, and I won't bore you with that diatribe.

**Marine-Street:** But it's supposed to be applied to the whole portfolio?

**Sharpe:** [00:02:35] In its initial, original form, yes. Again, you can do pieces of it, but you have to do some more statistics. It's more complicated.

**Marine-Street:** Do you remember when you realized people were calling it the Sharpe ratio and it had become a kind of standard?

**Sharpe:** I don't remember, and I can't honestly figure out who first started calling it that. It could have been Gene Farmer in Chicago, but I'm not sure.

**Marine-Street:** Another thing that people always mention about your research is your approach to the valuation of options, the binomial method, and I wondered if you could just say a little bit about that.

**Sharpe:** That's a lesson in why sometimes it's a good idea to spend your time as an academic--*some* of your time--writing a textbook. When I was doing the textbook and the course and I wanted to do quite a bit on options, the governing option theory was Black-Scholes--Myron Scholes at Stanford and Fischer Black, then at MIT, or in industry at some point and then Chicago.

[00:03:50] It was a very sort of continuous-time, mathy kind of thing. You could understand how to use it and you could do the calculations, but it was kind of hard to understand the economics. So I did what you do when you teach or write a textbook. I say, "Let's come up with something really simple. Let's take the simple example in which a stock can go up a dollar or down fifty cents, or whatever the numbers might be, in one period, which might be a very short period. Then after that, it could go up another dollar-and-a-half, or down, or it could go up maybe *x* percent or down *y* percent."

[00:04:39] Basically, in each period it can go one of two ways, and then in the next period it can go one of two ways, so you get this sort of tree structure. A binomial: it can only go two ways. That's the term. So for the textbook and for my class, I started saying, "Let's assume you've got four periods, and each period it can go up some amount or down some amount so that between now and the end, there are a lot of possibilities.

"Let's say somebody wants to give you a dollar if it goes up more than *x* and nothing if it goes down or falls below that. How much should

you pay for that? What's the value of that option, if you will? It's an option based on what happens."

It turns out that's a really easy problem to solve, and it's very intuitive. I was doing the example and drafting the chapter, and then I thought, "What if I have the same time period, but instead of four possible ups and down moves you have eight? Then what if you have sixteen?"

[00:05:55] So I wrote a little program, and it was a simple little program to keep playing around, making the time intervals shorter for a given time period, and *voila*, I got the results, virtually, of the Black-Scholes valuation model. I thought, "Well, that's really cool, and I can do so much more with this binomial pattern than I can with the Black-Scholes, but in the special case that the Black-Scholes covers, it actually, in the limit at least, gives the same result."

I remember showing it to John Cox, who was on our faculty, and he was then working on a paper with Steve Ross and Mark Rubinstein, Steve at Wharton and Mark at Berkeley. They were doing a paper on option pricing, and John said, "We need to put this in our paper. Why don't you come on as a co-author?"

[00:07:06] I said, "Ah, that's fine. Just give me a footnote," and so in the paper they did. They said, "Got this from Bill Sharpe." That became very important, and it had much, much more in it than this. That became a very influential paper, and I never published it, other than in my textbooks.

It was out there and people were reading the article, so it would have been redundant.

**Marine-Street:** It's so interesting how you arrived at that, though, because you were trying to teach it, and it's much more visual.

**Sharpe:** Yes, and it's sort of a lesson in computation versus analysis. The Black-Scholes was done using some pretty high-powered mathematics, and to actually use the binomial in practice, it's just brute force. You write a very simple computer program, and then you have a lot of little, teeny time periods and get the results you want or you need.

[00:08:06] That's not atypical, because my math is limited. Over many years I've resorted to computer programs to do things that a real mathematician could do on the back of an envelope probably.

**Marine-Street:** There's more than one way to skin a cat, right? [laughs]

**Sharpe:** Indeed. As we all know, as the cost of computation has come down, the efficiency of doing it brute-force on a computer, whether it be artificial intelligence or whatever, becomes close to dominant.

**Marine-Street:** Yes, and you can trace that.

**Sharpe:** You can understand it. [laughs] I can understand it.

**Marine-Street:** You can trace that in so many different fields. Somebody was talking about linguistics analysis, and the computer has come in to solve some of the problems.

**Sharpe:** Oh, yes. One of my grandsons is finishing a degree in computer linguistics

at Stuttgart.

**Marine-Street:** Very interesting. I wanted to ask you about the Princeton book, *Investors and Markets*.

**Sharpe:** In 2004 or 2005, somewhere in that range, I was invited to give a series of three lectures on subsequent days, at Princeton as part of an annual series, and so I thought through and decided I would try to bring together some things that I hadn't really fleshed out in my investments text or my portfolio theory text, my articles or monograph. The portfolio theory wasn't a text, it was a monograph.

[00:09:54] I put quite a bit of time into that and wrote a bunch of programs, of course, as is my wont. Then after the lectures, I thought and they thought it would be a good idea to turn it into a book. The title is *Investors and Markets: [Portfolio Choices, Asset Prices and Investment Advice]*. It tries to go beyond one-period capital asset pricing model into multi-period. It doesn't really do a good job of multi-period. I've done that subsequently. But it fleshed out a number of areas, and there was information and some empirical analyses. I hope it's self-contained, and so it's in book form.

**Marine-Street:** [00:10:50] I wanted to backtrack a little bit and ask you some questions about university service. I know there weren't a lot of committees at the GSB when you were there, but you did do some work involving the Computer Center. I hoped we could talk about that, as well as the Stanford Management Company.

**Sharpe:** Okay, let's start. When I first came to Stanford, we had a room down in the basement with I think they were IBM terminals. They looked like typewriters, and they were connected to the central campus computer in a time-sharing system that was advanced for its day but was kind of klugey. Somebody tended to that, but there was no real technology on our part. It was just, "Hey, you can use the central campus computer in the business school building rather than going over there."

[00:11:53] There came a point, not too long after I came to Stanford, when Hewlett-Packard introduced, if not the first, one of the first mini-computers that would service, in this case, thirty-two different terminals. I can't remember now the name--Ansolo. There was a young guy on the faculty who taught in the OR[stands for?] area, Hank Lucas. Hank and I thought, "The business school needs to have one of those." So we went to lunch with R.J. Miller, the dean, and said, "R.J., we really need to have this."

He said, "Well, how much does it cost?"

We told him whatever it was. It was a lot.

[00:12:41] I can't remember if he was on the HP board or if he knew everybody at HP, but he said, "I probably can get you one, but if I can't get it free, I'll pay for it. I'll find a way."

So we said, "That's great."

He said, "Okay, now, this is going to be a computer center with a

computer. Somebody needs to run it. Hank, you can't do it. You don't have tenure. You got to do research. So Bill, how about you doing it?"

I said, "Well, okay." So Rene Hammerman, the administrative assistant for the group I was in on the faculty, and I basically ran the Computer Center, installed it and ran it for a while. Then we hired a director, and then it grew and morphed over the years in different ways. But I was very involved in that. I remember we bought two Tektronix [machines]. They were sort of oscilloscopes, but they were cathode ray tubes. There wasn't any real software for it, so I wrote some graphics software for them so we could do graphics early on.

**Marine-Street:** [00:13:50] How cool.

**Sharpe:** That was great fun.

**Marine-Street:** So you didn't use the central university computers anymore at the GSB?

**Sharpe:** No. We had an absolutely brilliant director, and the micro-computers were coming in, the IBM micro-computer and such. [Then as it evolved], I and a couple of others--Hank had gone elsewhere--thought that we should convert to a room full of micro-computers, of IBM micro-computers, say. The staff felt very, very strongly that we should continue to have our own time-shared computer, and we eventually went to the micro-computer path.

[00:14:42] But back to the HP, about the time we got ours, I think in many cases afterwards, Harvard business school got one and a business school in France got one. So we set up an HP X, whatever it was, a business

school users group, and we had meetings and annual meetings in France or in the States, exchanging tips, and we exchanged software and all the rest. It was a lot of fun.

**Marine-Street:** Very interesting. What about the Stanford Management Company?

**Sharpe:** I worked with the Stanford Management Company when I had the consulting firm, and then at some point after I came back to Stanford, obviously we dropped that. But I was on the committee for the endowment--I think it was officially the board of the Stanford Management Company, which was a company that ran the endowment. I can't remember if we had a computer or not, but it ran the endowment. So I was on that board/committee, and they had a traditional faculty position. Jim Van Horne had been on it. Then I was on it for a while.

**Marine-Street:** [00:16:04] Did Stanford ever use any techniques that you had pioneered?

**Sharpe:** They were certainly using some of them at the board level, and I experience this in investment committees I'm on now. I'm the one voice not in the wilderness anymore, but crying out for, "How about low-cost, passive management, [laughs] wherever possible?" Typically, most of the members of that sort of committee are industry people who think that there are some ways in which you can do better with "active management," but that was a very, very comfortable committee.

[00:16:47] We were all good friends. We had very sensible and friendly discussions, and I like to think that I might have moved it a little bit

more towards lower-cost managers and more passive managers. It was a very, very satisfying time, and I learned a lot, which is my mark of boards. If I learn a lot, it's a good thing for me.

**Marine-Street:** I know at some point with the endowment, they moved from being pretty staid type of investments to doing more interesting, probably more risky things.

**Sharpe:** The thing that makes the Stanford endowment not unique, at least unusual, is Stanford has access to an awful lot of information--legally. I'm not talking about illegal information--about what's going on, particularly in Silicon Valley. So yes, I think there are some reasons, and it's very similar. Yale endowment has some special comparative advantages, and I would be the last to deny that or not want to take advantage of that.

**Marine-Street:** [00:18:10] Are there any particularly memorable Stanford moments that you'd like to make a part of this oral history?

**Sharpe:** Well, I'll tell you one. Shortly after I came to Stanford--I think it was in R.J.'s time, so it couldn't have been too soon, but it was definitely when R.J. was dean--Stanford business school had, and I think still has, an advisory board of high-level industry businesspeople, and some non-profits who come once or twice a year and learn about the school, and make suggestions. So R.J. asked me if I would be willing to give a talk on efficient markets and what I was doing.

[00:19:07] I said, "Sure." So they were out there in one of the

classrooms, and I gave my shtick. Of course it was about efficient markets, and diversify, and don't try to beat the market, and all that sort of thing, with enough theory to whet their appetite without boring them too much. I finished and R.J. said, "Well, that's all very well, Bill, but what do you say about Warren Buffett up there?" And sure enough, there was Warren Buffett.

I think I said, "Well, Warren Buffett's a three-sigma event," which in statistics is a very unusual event. It's way out at the far tail of the probability distribution. I didn't have a chance to talk to Warren afterwards. I don't know that we've ever talked, but somehow or other, there was this kind of, "Okay, I'm in the big-time now. [laughs] This is not UC Irvine."

**Marine-Street:** [00:20:14] Oh, that's a great story. I was thinking about moments, and you've been through lots of interesting stock market moments, I'm sure.

**Sharpe:** Oh, indeed.

**Marine-Street:** I wondered if there's any kind of downturns, or crashes, or stock market events, or legislative events that stick in your mind.

**Sharpe:** Oh, yes, very much. This group I mentioned, the Institute for Quantitative Research in Finance, was meeting in Colorado at some resort. I can't remember the name now, but we were out there in this bucolic environment on Black Monday, the day that the market fell--I can't remember how many points it was. It was a monumental market crash, and it was interesting because many of the members of this group, at that point in particular,

managed portfolios either as investment managers or as pension people.

[00:21:26] So we started getting word. There was somebody speaking, and it was a conference setup. Somebody would come in and whisper to somebody, and there'd be one of these things where there was buzzing and whispering. People would get up and leave, and finally stop the proceedings and found out the market was falling twenty percent or something like that. It was humongous.

But we kept soldiering on with the conference, and what was interesting, the people who left were the pension officers and the endowment officers, because they had purview over bonds, and stocks, and real estate. One part of their portfolio was sinking like a rock, and the question is, what do they do now?

[00:22:20] The people who stayed were, for example, the managers of a stock index--not an index. We had index fund managers, but say, a manager of growth equities, because that manager's charge was to invest all the money that the client gave him or her in growth equities, so they didn't have anything else they could do. They couldn't sell the growth equities. That wasn't in their charge, so they stayed around.

The minute the session broke, everybody went to television sets to watch the proceedings. Then in the afternoon session, we started at four. I remember it distinctly. There was a paper that Sandy Grossman, then at Wharton, had written about portfolio insurance, which was actually created

by Hayne Leland and Mark Rubinstein, now retired from Berkeley. That was at least considered the culprit. It was a procedure which, if the market fell, it would automatically sell a bunch of your stocks, and then if it fell some more it would sell more.

[00:23:35] Sandy had written a paper--he'd actually put it to bed a week before, so this was clearly done before this event happened--saying, "Look, having all this money with computers poised to sell stocks if they fall, and with the rest of us not knowing how much money is invested in that scheme, could cause a major market crash." So here was Sandy giving this paper to an almost empty hall--the academics and some of the money managers were still there. It just nailed it, and it was the spookiest thing in the world.

[00:24:16] Then just to finish that story, after the conference I had to go to New York, and a TV network for some late-night business show or something--and I guess the *Journal* or the *Times*--caught up with me. I did an interview, but I think it was the *Journal* that quoted me and said, "Well, what caused this?" I said something equivalent to, "Damned if I know," to which my mother said, "Three degrees in economics, all that time in school, and all you can say is you don't know?" [laughs]

**Marine-Street:** I think you said, "It was really weird."

**Sharpe:** Is that what I said?

**Marine-Street:** [00:25:08] I think I read that you said that.

**Sharpe:** Okay, well, you're way ahead of me. "It was really weird," or something. [Marine-Street laughs] But in any event, that was a pretty dramatic time.

**Marine-Street:** Yes, it sounds like it.

**Sharpe:** There's still some controversy as to why that happened or to the extent the portfolio insurance actually exacerbated, if not caused it.

**Marine-Street:** So after events like that, would you get a lot of calls from people questioning your theories or saying, "Why didn't you think about that?"

**Sharpe:** Well, my theories were kind of agnostic on whether the market itself would go up or down, or what might cause it. My assumption--I wouldn't call it a theory, it was an assumption--was that market price is generally an unbiased forecast of the value of the range of things that might happen in the future, and variants on that theme.

[00:26:10] I didn't have a lot to explain about that, but people said, "In your empirical models, you assume a certain probability distribution, and this is way at one end of that probability distribution. Are you sure you've got the right probability distribution?" But that's implementation and not theory.

**Marine-Street:** I always figure one of those events will happen about a week after I put my money into something. So that's called the Natalie Marine-Street ratio. Speaking of memorable moments, I'm sure one of them occurred in 1990 regarding the Nobel Prize, and I wondered if you could just narrate that event for us.

**Sharpe:** [00:26:55] Oh, my. My wife Cathy and I, were at a conference in Tucson. I was supposed to give a paper. About 5:00 a.m. or 5:15 a.m., the phone rang, and there was this chap with a strange kind of European accent. There'd been a fellow calling me at odd hours from somewhere in Europe for a few months, wanting me to give a talk. He kept calling, and he didn't quite have a concept of the time. I thought, "Oh my God, it's this guy, and how did he know I was in Tucson?"

As they do, this was from the Academy, of course, the Swedish Academy. They have a way of sort of easing you into, "Yes, this really is the Nobel Prize, and it's authentic," which they did. So we got up, of course, and we turned on CNN, because we still were not entirely sure. It was given to me, Mert Miller from Chicago, and Harry Markowitz. CNN's first version of it had two or three things wrong, but they had the story. Then every few minutes they repeated it and they got more of it right.

[00:28:41] We watched that for a while, and then we went out and sat on the little patio area and watched the sun rise over the desert in Tucson. Then all hell broke loose. I went down to the meeting--it started at 8:30 a.m., I think--to tell them that I wasn't going to be able to give the paper because I had to man the phones. One of my good friends, Marty Leibowitz, said, "Just a minute, Bill," and he gave this wonderful, sweet talk with a great Yiddish proverb, I think it was. It was just wonderful, and they all stood and applauded, and then they wheeled in a cart with champagne

for everybody at 8:30 a.m.

[00:29:34] Meanwhile Stanford had called and said, "Look, you need to do press calls." The hotel had given us a suite, and so I manned a phone, my wife manned a phone, and then they somehow or other, Stanford got somebody to come in from Tucson to help man a phone. Then they set up a press conference and had a big banner arranged to hang behind me for the press conference.

**Marine-Street:** Oh, neat.

**Sharpe:** It was amazing, and of course central campus had experience with Nobel Prize ceremonies. It was wonderful because we'd driven to Phoenix. We flirted with flying back and have somebody drive the car back, and I said, "No, I think we could use a day-and-a-half of sanity." So we had this nice drive back, and peace and quiet through the desert. Then we got home it was crazy.

**Marine-Street:** [00:30:35] How did the GSB react?

**Sharpe:** As any academic Nobel Prize winner could tell you, within a day or two all your colleagues say, "Well, what have you done lately?" Of course, in my case, the citation was to my 1964 paper, and this was 1990, so it was a particularly poignant comment. I was still in the firm, so I wasn't actually on campus, but the finance faculty used to have lunch once a week in the Faculty Club together in a room and I would go to that.

[00:31:18] Then I found the solution: how did the [Nobel] committee

know where I was? One of my colleagues, [Ingrid Werner] was Swedish and the committee had contacted her a few weeks in advance and said, "Look, Bill is being considered. That doesn't mean he's going to get it, but he's being considered and we need to know where he'll be on the night of such-and-so." I don't know if that was quite true or not.

She told me afterwards she went to the PR department of the business school and said, "I'm having a lot of trouble remembering who is Bill Sharpe and who is Bob Wilson. They both have beards. Could you give me a picture?" because they needed a photo. "Could you get a nice photo of Bill Sharpe?" So she got the photo for them, and then I remember at a luncheon she seemed to be very curious what I was going to be doing. I said, "I'm going to the Q group."

[00:32:26] "Oh, really? Where is it?"

"It's in Tucson." Then I'm not sure how she tracked down which hotel I was at. She probably contacted the group, and that was the conference hotel. She's at Ohio State now, but I see her from time to time.

**Marine-Street:** So that was the Swedish intelligence operation.

**Sharpe:** Oh, yes. They're good.

**Marine-Street:** Oh, that's funny. Did you go to Sweden for the ceremony? Tell me about that.

**Sharpe:** Oh, yes. We had the extended family. We had my mother, my father, my stepmother. We had my two kids, one of Cathy's, my wife's kids. We had

my cousin from Virginia, and then Bob Litzenberger and his wife came over. So we had a party of twelve, and they put us all up at the primo rooms at the main hotel.

[00:33:33] It was magic. It was astounding. You may have seen others who've talked about this, that you're royalty during that week, and it was over a week. They've cut it back, but in my day it was almost two weeks. You're giving lectures, and you're going to this, and you're going to that. It's really draining, but fabulous. Basically, people line up the streets to see you, and it's like you almost want to give a Queen Elizabeth wave. [Marine-Street laughs] It's very heady.

**Marine-Street:** How did you decide what to talk about during your address?

**Sharpe:** You get the notice in October, and the address is in early December. So I did a sort of a reprise of the CAPM and then some modifications, so it was about half old, half new. Then it was published, in our case, in the *Journal of Finance*, which was the main journal for financial economics at that time. That was a lot of work. Plus, I just had to tell the others at the firm, "Look, you guys do whatever needs to be done. I'm going to work on this, plus letters." There was no email in those days, and it was a very different time.

**Marine-Street:** What would you say the impact of receiving that prize has been?

**Sharpe:** It's interesting. It's almost binary. Some people say, "I'll do the grand tour, for a year. Then I'm going back to the lab," and others say, "Well, I now have a bully pulpit." A couple of the physicists in our year said,

"Look"--they were really big on some of the public policy issues--"I'll give lectures here and there for a while, but then I'm going to devote most of my time to informing the public about climate change, about nuclear problems, *et cetera*."

[00:35:55] So I went back to work. In my research/practical activities, there was a period in which I was focusing on the problems of pension endowment funds into the 1980s and early 1990s. Then when I went back to Stanford you could see this tectonic shift from typical, old-fashioned defined benefit plans to defined contributions: "If you want to, you can put some money aside, and we, Mr. and Mrs. Employer, will add a little, and you can invest in one of these mutual funds and good luck to you." It seemed to me that people really needed help, so I focused my research and practical activities on that phase.

[00:36:57] Then there was a period when I was having coffee with Joe Grundfest from the law school, and he was saying, "Look, Bill, what you're doing is great, but if you put it in academic articles it won't affect the working stiffs for years and years. You need to form a firm."

I said, "No, I've been there, done that. I'm terrible at it."

But he said, "Well, I'll introduce you to this friend." He introduced me to Craig Johnson, who ran a firm that basically helped people like me start firms. So in 1996 Craig and Joe and I founded a firm called Financial Engines and focused on helping employees of firms. Our client would be

the employer, and then we would help each of the individuals understand the range of things that could happen, how much they should save.

[00:37:55] That firm went public. I retired from it pretty much at that point, and then it's just recently become private again. I think it went private for three billion dollars, and they have a lot of firms and a lot of employees they're trying to help. So that was phase two.

Phase three, which I started a few years ago on research mode, is, "Okay, you've just retired. You've got your 401(k) savings plan. What do you do now? Do you buy annuities? Do you invest? If you invest, how do you invest? If you invest, how do you decide what to spend?" There's so much money coming out of those plans now that the investment industry, the insurance industry, and sundry other industries are all in there with products, services, and advice, so there's a lot going on.

[00:39:03] People typically haven't saved enough to begin with. A lot of help is needed, and there's some really meaty problems. So over three or so years I wrote what is now an e-book and a whole suite of software, which is on my website at Stanford, and it's all public domain. You can use it for anything without charge. It tries to address some of the issues and provide analysis of some of these alternatives in a structure that has a good underpinning economically, the so-called multi-period asset pricing model, and takes into account actuarial information and such. That's been my most recent project, and now I'm sitting around waiting for somebody to pay

attention to it, [laughs] without apparent success.

**Marine-Street:** [00:40:01] Is the idea that if I was a retiree I could get your program and plug in my particulars?

**Sharpe:** No, you could go to somebody who would hopefully not charge you too much, who would have my program--

**Marine-Street:** I see. So I couldn't do it myself.

**Sharpe:** --and work with you to try to get a sense of the alternatives and the tradeoffs, and then craft a program for you, hopefully involving very low-cost index funds, [laughs] and then a sensible rule for spending, and some mix probably of annuities and investment in a spending rule.

A couple of the local investment advisory firms have looked at it, had somebody read it, and have asked me to come make a presentation to them and some others, some of their friends from other firms. But I don't know of any real uptake on either the analytic, the book, or the software, or better yet, both. But I'm hopeful. It took time for most of my early work to catch on, so I'm hoping that something will happen.

**Marine-Street:** [00:41:13] Would it end up with a visual component?

**Sharpe:** There's a lot of visual, a lot of graphic output. The software can produce oompty-oomph different kinds of graphs. You can choose which you want to see or you want to show your client, and a lot of graphics. I'm very graphical, as I think we mentioned.

**Marine-Street:** Did you write this all yourself?

**Sharpe:** Yes. I've generally been pretty much a lone wolf, but I've done some co-authored works.

**Marine-Street:** What language are you writing in nowadays?

**Sharpe:** [00:41:48] MATLAB, which is a matrix-oriented mathematics language, that you can get free at Stanford or most major universities and colleges. One of the drawbacks is you do have to pay for it if you want to use it commercially, but it's marvelous. It's solid as a rock, and it's a beautiful language.

**Marine-Street:** The program seems like it's really needed. I wish you the best of luck on it.

**Sharpe:** I think it's needed, but I should have written three books, a book for the head of the consulting firm, a book for somebody who does some other work but isn't a programmer, and a book for the programmer in the back office, and I didn't. I just wrote one, and so the programs appear within the chapters with little comments: "By the way, you might want to skip this." So it's not well-organized, but it was a big undertaking. I just needed to get it out of me and out in some form people could use.

**Marine-Street:** [00:43:03] In our remaining moments, I wanted to ask you a little bit about your extracurricular activities. I know that you are a great music lover.

**Sharpe:** I am.

**Marine-Street:** I wondered if you could tell me about what you've been doing in that regard.

**Sharpe:** Well, I'm a very bad musician. I played the upright bass quite badly and

played a little bit around the Monterey area, traditional jazz mainly. But I had two shoulder replacements and decided maybe that wasn't the best instrument for me. So in terms of playing, I just play piano now. Cathy claims to like hearing it, and the dogs don't leave the room anymore when I play. They did sometimes when I played the bass. So that's pretty much that.

[00:43:54] I've had many sailboats, but no sailboats now. I have a little twenty-three-foot electric powerboat in Monterey Bay. It gets me out on the water, although like most boaters, I don't use it as much as I should.

Then for non-profits, I've been on the board of the Carmel Bach Festival. Eighty years we've run and it's fabulous, and everybody should come. I'm also on their investment committee. I've been on the investment committee of the local community hospital for a number of years, and I've been on the investment committee and now the board of the Community Foundation of Monterey County. I teach Scratch language programming to eleven-year-olds in a summer program in Seaside. I guess that's pretty much it.

**Marine-Street:** [00:45:01] Do you do any sailing anymore?

**Sharpe:** I don't. Monterey Bay is not a particularly good place for the infrequent recreational guest because it can be cold. We have actual waves, [laughs] and so it's not like sailing in Southern California or on a nice lake in New England. I tended to do a lot of sailing with the dog, and the dog wasn't any help at all setting up and breaking down. The little electric boat I jump in

and cast off, and go out and come back.

**Marine-Street:** [00:45:40] Right, a little easier. Now you were telling me that you still get together with some of your Stanford colleagues from time to time. Can you tell me about that?

**Sharpe:** I do. I'm having lunch with Jim Van Horne next week, I think. I'm having lunch with Joe Nation from the SIEPR pension project that we haven't talked about, but I think the next week, and maybe Jeremy Bulow and others. We basically meet either in Scotts Valley at a Japanese restaurant or sometimes in Santa Cruz. We try to split the difference for the drive and have three-hour lunches.

**Marine-Street:** We have a few seconds. Can you tell me about the SIEPR pension project?

**Sharpe:** [00:46:21] This is a project. Joe Nation is the mover and shaker, and I'm an advisor with Jeremy Bulow and a couple of others. Basically, the goal originally was for California, both the central pension, CalPERS, and CalSTRS, the teachers' pension, and then for all the cities' and counties' pension funds, many of which are invested with CalPERS, to get a lot of data and produce a website where you could find data. It's been extended to all the states now, and Joe and his team of students and programmers keeps that up.

When you strip it down, the big economic issue is in the public domain you have a pension fund, and it's pretty clear what the value of that is. It's stocks, and bonds, and maybe some private equity, but you can value

it. So our assets are worth a hundred, let's say. Then you have commitments to pay people after they retire, and those are very complicated.

[00:47:40] The question is, what is your liability? What assets would you need to be sure you could make the payments that have been accrued for people in service up to date? If everybody quit tomorrow, how much money would you need to be sure to pay them?

The economists said, and I wrote about this in the 1980s, "The answer to that is pretty obvious. You say, what would it cost me to buy a portfolio of US government bonds that would make payments that would provide cash as needed for all those people as they retired and then died?" In the private sector, that's pretty much the way the actuaries calculate liabilities for defined benefit plans. In the public sector, they have, for various reasons which at root are political in a broad sense, used a discount rate which is not the rate on government bonds. It is what economists would say you should use, but their expected return on their portfolio, which is typically much higher. So their official asset-liability numbers show that maybe they're seventy percent funded. It should be a hundred, but they're seventy. If you do it right, it's more like forty or thirty.

Again, there are many, many aspects of this project, but one of the key aspects is we try to make that calculation of what we call the market value of the liability is, as opposed to the actuarial value. Of course, we get a lot of pushback from the funds, from the state actuaries, *et cetera*, but we

persist. The information is out there, and it's absolutely frightening. California is one of the very worst. It's a terrible problem. It's a problem that looks bad on the surface as they report it, but it's far, far worse and it's a terrible public policy problem.

**Marine-Street:** Wow.

**Sharpe:** So we soldier on, and the site is just California Pension Fund. You can find it online, and the software is really good. Joe and his changing cast of students, and a few professional programmers somewhere else--they're not on staff--keep it up.

**Marine-Street:** Interesting. My final question for you: I'm sure that you've had lots of things that you hoped that you would be able to get to during your career. As you have finished this program that's on your website now? If you had another fifty years, what would you want to work on next?

**Sharpe:** [00:50:36] Oh, man. I really don't know. There are many things that finance can do, but one of the key things is allow people to have their consumption pattern over their lifetime differ from their income pattern. Save money while you're young and earning it, and invest it. Then spend it when you're old, *et cetera*. It's sort of changing one time-pattern of income and creating a different time-pattern of expenditures.

I've tried to take on the various pieces of that, and there are some focus things that I'm intrigued with, some interesting products that are half insurance and half investment that the industry is providing. I've analyzed

them a bit in the last chapter of my e-book, but it could certainly use some more analysis and work.

[00:51:40] But big projects, no, and that's because especially with this last project, I'd been up to my ears in mortality tables. I've looked at mortality in Sweden in the 1600s, these massive databases. I'm very conscious of the fact that I don't have fifty more years, so I haven't really addressed that kind of issue.

**Marine-Street:** Thank you for doing this oral history. It's been fascinating.

**Sharpe:** Thank you for all the time and effort you've put into it, not just the four-plus hours we've spent together here but all the prior work you did on it. It's very much appreciated.

**Marine-Street:** [00:52:21] It was an honor. Thank you.

**Sharpe:** Thanks, Natalie.