True Value:
An Investigation into the Valuation Behavior of Land Developers and Appraisers

by

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B.A., History and Fine Arts
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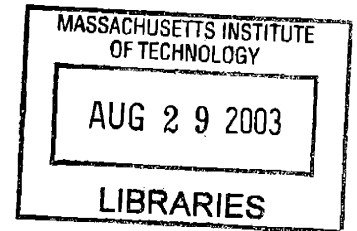Requirements for the Degrees of

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1

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ABSTRACT

The goal of this thesis is to investigate the real world problems associated with valuing a key component of real estate -- raw land. Because land valuation is seen as a risky endeavor that requires investors to make decisions based on outcomes that are uncertain, it offers a unique and interesting realm for evaluating human decision-making behavior.

Through contrasting the three different decision processes of 1) the normative approach to valuation that appraisers are trained to employ 2) the true valuation behavior of appraisers in the field, and 3) the true valuation behavior of land developers in the market place, this study seeks to gain insight into real estate valuation behavior.

The hypotheses for this thesis are drawn from the core theories of decision analysis and cognitive psychology. Because this study looks at the process of valuation, it focuses on the cognitive shortcuts, formally referred to as heuristics, that humans use to make decisions in complex situations where the outcome of a task is uncertain.

In this study, a process tracing technique was employed to study the problem solving behavior of nine land developers and ten appraisers. To compare subject processes, protocols were conceptualized as frequency distributions and were compared using Kolmogorov-Smirnov goodness-of-fit tests as well as parametric tests of equal population proportions.

The results of the tests showed that according to a model developed by the Appraisal Institute, appraisers and developers behave in a non-normative manner for they take certain cognitive shortcuts that end up altering this model when valuing an asset. The information search behavior of appraisers and developers was also found to be observably different. Further investigation discovered that appraisers look at more comparables than developers, while developers tend to be more interested in incorporating valuation steps that are not prescribed by the normative model.

The findings of this study lead to serious questions about the efficacy of the AI's current model. In fact, the deviations between appraisers' methodologies and those of the market, as represented by the developers tested, were such that if these discrepancies are not addressed the work of appraisers risks becoming marginalized. Implications for future research were also discussed.

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Table of Contents

Bibliographic Note

The author graduated *magna cum laude* with Distinction in 1999 with a B.A. in History and Fine Arts from Amherst College in Amherst, MA. Her experience within the real estate industry includes working at Catellus Development Corporation on the Mission Bay Project. As part of the land development group, she focused on infrastructure coordination, public private partnerships and open space planning. In addition, the author has experience assisting in the evaluation and acquisition of land and building investments in conjunction with Wolff Companies, a family owned company.

Acknowledgements

Chapter I: Introduction

A) Overview and Statement of Problem

This thesis investigates a fundamental aspect of real estate -- the techniques and methods used to value an asset. To understand this process it looks at the most basic and speculative product type in the industry, raw land. Because of its unpredictable nature, land investment has historically been considered somewhat of a "black-box" that requires investors to draw conclusions, make hard decisions, and take risks based on outcomes that are uncertain. People traditionally see land speculation as a perilous and dicey endeavor because the value of the land is not based on more objective measures such as a current income stream or an existing tenant base, but on subjective judgments about a property's future potential. Therefore, because of land valuation's inherently speculative nature, the valuation process that it requires provides a unique and interesting realm for evaluating human decision-making behavior.

Two of the major sets of professionals who participate in the practice of valuing raw land are land developers[1] and appraisers. The market and appraisers have historically been known to assign different values to the same asset. Developers often complain that appraisers' analyses are inaccurate and flawed because they rely too much on historical data and do not incorporate key elements and market fluctuations that can quickly alter

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[1] In this study the title "Land Developer" refers to individuals in the market place who routinely purchase raw land. While each member of this category may enter this process from a similar point, they possess a variety of different exit strategies for capitalizing on the property's assets and eventually turning a profit. For example, some see it as a speculative play and will merely sell the land to another individual to develop, while others feel that the only way to make money and create value is to buy the land and then develop it themselves.

the value of an asset. Because of its inherently volatile, speculative and nebulous nature, nowhere is this disparity more prevalent than in land valuation.

Therefore, it is believed that through comparing and contrasting the decision-making behavior of land developers and appraisers, one can obtain an interesting and insightful perspective on real estate valuation behavior and on mechanisms which cause this disparity. This study seeks to gain insight into valuation behavior by comparing three different decision processes: 1) the normative approach to valuation that appraisers are formally trained to employ, 2) the true valuation behavior of appraisers in the field, and 3) the true valuation behavior of land developers in the market place.

A notable amount of research has been done recently on informational processing and decision-making in the realm of real estate appraisal. Behavioral research on appraisers has revealed that like many human problem solvers, appraisers have a need for cognitive efficiency to overcome natural informational processing limitations. While some of the short-cuts that valuers subconsciously develop are positive, many result in biases and errors that reduce accuracy and performance.

Most of the research on real estate valuation has focused on the appraisal valuation processes and not on the methods that actual buyers and sellers employ when establishing the market value of an asset.[2] Therefore, this thesis breaks new ground in the study of real estate valuation. It examines the relationship between the valuation behavior of appraisers and land developers. It explores theories about human decision-making derived from the field of cognitive psychology, which have only recently been examined in the context of decision-making and property. The methodology used in this

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[2] Diaz, Julian III (2002). Behavioral Research in Appraisal and Some Perspectives on Implications for Practice *RICS Foundation Research Review Series*: 12-13.

research is also somewhat novel for the field of real estate, comprising a controlled experiment (a simulated valuation of a raw piece of land) that allowed the direct observation and analysis of the decision-making process as well as the output of the valuation. This was achieved by applying a data collection technique derived from experimental psychology called "process tracing." Process tracing provides significant insight into the valuation process by providing a means to map out a subject's solution path. Through obtaining this insight it is hoped that light will be shed on the mechanisms that typically cause valuations to differ and be inaccurate, thus leading to an improvement in the process of real estate valuation for both appraisers and developers.

B) Thesis Organization

The organization of the balance of this thesis is as follows: Chapter I provides an introduction to the research problem and offers justification for this research effort. Chapter II lays down the theoretical basis of this study. It specifically provides an overview of the core theories of cognitive psychology that pertain to the study of property valuation. Chapter III reviews the literature that is relevant to this thesis. Past studies performed on the valuation behaviour of appraisers as well as literature on the gap that exists between appraisal values and transaction prices is covered. Chapter IV is dedicated to explaining the thought process behind the five hypotheses developed for this study. Building on this, Chapter V explains process tracing, the methodology that was employed to test these hypotheses as well as the solution sequence model that was developed to perform an intrastudy comparison between land developers and appraisers. Chapter VI presents research results and examines each of the five hypotheses that were tested.

Finally Chapter VII offers the conclusions of the research effort, while Chapter VIII discusses implications for future research.

Chapter II: Theoretical Basis

A) Purpose of Theoretical Base

This section of the thesis presents the theoretical base of the study. It looks at how research from the field of cognitive psychology has illustrated the ways in which human beings reach decisions when faced with problems. These theories provide a basis for the development of the hypotheses about subject performance that are presented in Chapter IV.

Because this study looks at the process of valuation, it focuses on how humans make decisions in complex situations where the outcome of a task is uncertain. In these situations humans employ cognitive shortcuts known as *heuristics* to aid them with the issues associated with information processing. Heuristics can be defined as rules or patterns that help to reduce the complexity of decision-making.[3]

B) Basic Theory

Now known as leaders in the field of cognitive psychology, the Nobel Prize winner, Herbert Simon and his colleague, Alan Newell, developed an approach to studying human problem solving that fellow economists call "behavioralism." This work served as the basis for artificial intelligence and found that the mind is a serial information processor that, because of limited capacities, must seek efficiency when solving problems. Newell and Simon found that while the mind has quite extensive storage capabilities it is limited in terms of its retrieval capabilities. Referred to as *bounded rationality*, this condition prompts humans to find ways to simplify the decision-

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[3] Harvard, Tim. An Examination of the Relationship between the Anchoring and Adjustment Heuristic and Variance in Commercial Property Valuation: a Process Tracing Experiment, *The Cutting Edge*, 2000.

making process and reduce mental effort. While these shortcuts can often help humans to deal effectively with the limitations of the human mind and efficiently solve problems within a certain "space," they can also lead to errors and biases in judgment. [4]

Amos Tversky and Daniel Kahneman performed pioneering work on the specific types of cognitive shortcuts taken by the human mind. These psychologists identified four main heuristics that they believe humans routinely use when making judgments:

1) the *representative heuristic*,

2) the *availability heuristic*,

3) the *anchoring and adjustment heuristic*, and

4) the *positivity heuristic*.

Representativeness is one of the most important heuristics identified by Tversky and Kahneman. It is similar to stereotyping and shows that most people perceive the likelihood (or probability) of something occurring based on how certain characteristics are familiar (or representative) to them. Decision-makers essentially classify an event or object with others of a certain class-type with which they have experience. Assumptions are then made that the subject in a task is the same as the ones with which they are familiar. While representativeness proxy speeds up cognition, it sometimes produces incorrect answers. This is because representativeness as a proxy for probabilistic thinking only works as long as similarity is an accurate predictor of the true probability. [5]

The *availability heuristic* suggests that a choice is made based on how active certain information is in one's memory. Since data collection tends to be based around the ease of retrieval, the decision maker will choose the most recent information recorded

[4] Newell A and Simon H. *Human Problem Solving*. Prentice-Hall, Englewood Cliffs, N.J, 1972.
[5] Tversky, A., and D. Kahneman. Availability: A Heuristic for Judging Frequency and Probability. *Cognitive Psychology* 5:207-232, 1973.

or the information most easily recalled.[6] For example, when asked if strokes or accidents (all types of accidents) cause more deaths on an annual basis in the United States, most people reply that they believe accidents cause more deaths. However, in a typical year around 167,366 deaths are the result of a stroke while only 97,860 are the result of an accident.[7] The central reason for the disparity between people's perception and reality is the availability heuristic. Television and media play up and talk more about deaths caused by accidents and as a result this information is more salient, vivid and easy for people to quickly retrieve from their memory banks.[8]

Anchoring is an adjustment heuristic (or rule-of-thumb) with which humans make value estimates by starting from an initial reference value and adjusting from this reference point as information is assimilated. Anchoring involves giving disproportionate weight to the first information or value received. Sometimes even arbitrarily set and outrageously extreme values are used as anchors.[9] For example, anchoring plays an important role in negotiations. Final agreement prices are more strongly influenced by first offers than by the subsequent concessionary behaviour of one's counterpart, especially if the parties only have a vague idea of their counterpart's interests and reservation prices. [10]

The fourth heuristic, the *positivity or confirmation bias*, was identified after it was noted that humans have a fundamental tendency to seek information consistent with their

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[6] Tversky, A. and D. Kahneman. Availability: A Heuristic for Judging Frequency and Probability. *Cognitive Psychology* 5(2): 207-232, 1973.

[7] Bertsimas, Dimitris. *Data, Models and Decisions: The Fundamentals of Management Science.* Cincinnati, Ohio: South-Western College Publishing, 2000.

[8] Tversky, A. and D. Kahneman. Evidential Impact of Base Rates. In: Kahneman, D., P. Slovic and A. Tversky (eds.). *Judgment under uncertainty. Heuristics and biases.* Cambridge: Cambridge University Press: 153-162, 1982.

[9] Plous, S. *The Psychology of Judgment and Decision-making.* New York: McGraw-Hill, 1993.

[10] Bazerman, M. and M.A. Neale (1992). Negotiating Rationally. New York: Free Press, Chapter 4.

current beliefs and avoid the collection of potentially falsifying evidence. Basically, humans adopt strategies that confirm rather than refute their beliefs. This tendency backs up the premonition that humans look for ways of validating their individual perceptions of the world.

While this study is primarily concerned with the theories that illustrate the negative aspects that result from using heuristics, it is also important to consider these cognitive shortcuts in regards to rational and irrational behavior. The term rational is defined in this study as maximizing a function in order to get a satisfactory and effiecient outcome. Heuristics often lead to errors and biases in judgment. Because these results are unsatisfactory, the act of employing a heuristic is commonly seen as irrational. However, employing heuristics can also be seen as rational. For instance, in a situation where there is a limited amount of information as well as a pressing need to make an expeditious decision; employing certain cognitive shortcuts can in fact help one to achieve the most efficient solution. In these types of situations heuristics are categorized as rational behavior.[11]

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[11] Quan, D. and J. Quigley. Price Formation and the Appraisal Function in Real Estate Markets. *Journal of Real Estate Finance & Economics* 4(2): 127-146, 1991.

Chapter III - Literature Review

A) Valuation Behavior of Appraisers

In order to provide a basis for a study on the valuation behaviour of developers and appraisers two different literature reviews must be performed. The first investigates the literature that has been written on the valuation behaviour of appraisers.

While most of the biases and heuristics that Tversky and Kahneman identified are typically used in decision-making, it is the "anchoring and adjustment" heuristic that the majority of studies in valuation have examined. Several studies have explored the tendency of appraisers to anchor to previous values. Within these experiments it was noted that subjects adjusted a low previous valuation upward more often than they adjusted a high previous valuation downward. In other words, they were more likely to give disproportionate weight to and make inadequate adjustments from valuations that were on the high side of an asset's potential value spectrum as to one that were on the low side.[12]

Experiments also provide evidence on how people behave when appraising properties in markets that are familiar to them as opposed to new territory. When an appraiser knows an area he or she is much less likely to be influenced by previous value opinions of others, such as anonymous experts. On the other hand, if they unfamiliar with an area's market they are much more likely to latch onto and be influenced by the previous value opinions of others. In line with this train of thought, experiments also show that less confident, novice appraisers are more likely to be influenced by previous

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[12] Diaz, Julian III. How Appraisers Do Their Work: A Test of the Appraisal Process and the Development of a Descriptive Model. *The Journal of Real Estate Research* 5:1(Spring, 1990), 2-3.

value opinions as opposed to experienced, tenured appraisers who are more at ease with their own judgements.[13]

Investigation into heuristic problem solvers and potential biases among appraisers has also shown the effects of the availability heuristic and specifically the notion of "recency." Studies suggest that the order in which an appraiser processes evidence may influence their conclusions. Valuers seem to give the greatest credence to information most recently considered for it is likely the most vivid and easily accessible chunk of information that they have stored in their mind. Therefore differences in information sequence-- for example, the order in which comparable sales are examined-- may evoke different interpretations of the same set of evidence and therefore may lead to different value conclusions.

The positivity heuristic, also referred to as confirmation behaviour, has also been observed in studies performed on appraisers. Confirmation behaviour occurs when valuers make early, preliminary value judgements and then over-weight evidence supporting these early opinions. Studies which show this behaviour looked at situations where expert income property appraisers valued a commercial property and then re-valued it some months later. These results indicate that appraisers may often insufficiently update their previous value judgements in light of available market evidence. Instead of looking at each property anew, appraisers in these situations often settled on values that solidly back-up and agree with previous judgements at the cost of ignoring notable changes in the market which warrant a greater adjustment. [14]

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[13] Diaz J II and Hansz J A. How Valuers Use the Value Opinions of Others, *Journal of Property Valuation and Investment* 15(3):256-260, 1997.

[14] Diaz J II and Hansz J A. The Use of Reference Points in Valuation Judgment, *Journal of Property Research* 18(2): 141-148, 2001.

Researchers speculate that that this tendency is the result of the fact that once valuers form an opinion of a market, they more heavily weight evidence that supports that opinion than evidence that disputes it.

Evidence that valuers may be victims of confirmation bias has also prompted a discussion about the nature of property value updates. People have speculated that appraisers often insufficiently adjust original values because the valuer is usually under pressure from the client to justify his previous judgements. Furthermore, valuers worry that a significant change in a value estimate will erode client confidence even if market conditions justify the change.

A variety of studies have also been conducted to look at appraisers' response to feedback and client influences. Research supports the view that the heuristics that appraisers employ may also be an unconscious, routine response to client pressure. In general, client pressure on valuers as well as the tendency for valuers to succumb to this pressure has been found to be substantial. The types of pressure that clients put on appraisers ranged from over emphasizing positive property attributes and withholding negative information to such coercive tactics as threatening to withhold fee payments and future assignments.

Studies revealed that appraisers exposed to above average levels of client feedback tend to define the value objective differently.[15] While the majority of appraisers view their roles as providing an independent opinion of the market value of an asset, studies suggest that those exposed to the greatest degree of client pressure may tend to see their role as validating a pending sales price. It is also interesting to note that when

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[15] Wolverton M and Gallimore P. Client Feedback and the Role of Appraisers, *Journal of Real Estate Research* 18(3): 415-432, 1999.

valuers were pressured, they tended to be influenced by the importance of the client but not by the size of the requested adjustment.

B) The Value Gap between Transaction Prices and Appraisal Values

The second section of this literature review investigates what has been written in an effort to explain the fact that appraisal values and transaction prices often differ by a notable amount. Most of this literature centers on the fact that placing a value on a piece of property (especially in the private markets) is a tricky business because real estate is an industry which is inherently informationally inefficient and possesses a great deal of purely random error (a.k.a. "noise"). There is some statistical and clinical evidence that for typical properties such noise or error has a magnitude of around 5% to 10% of the property value.[16]

Figure 1

That is: **Std.Dev.[ε] = 5% to 10% (price dispersion)**
Std.Dev.[u] = 5% to 10% (appraisal dispersion)
Probably larger for more unique properties.

Possible Transaction Price Probability Distribution
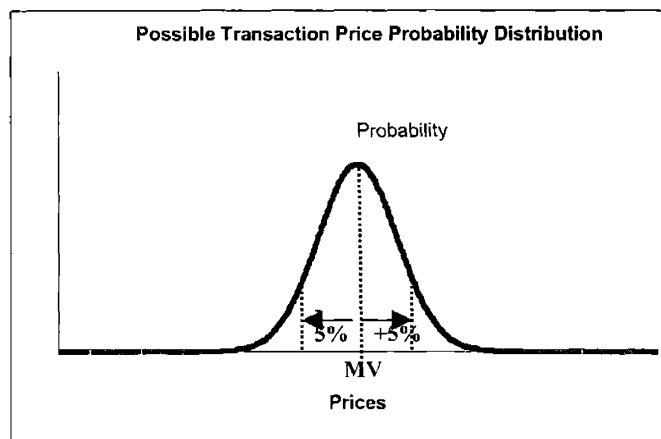
[16] Geltner, David and Miller, Norman. *Commercial Real Estate Analysis and Investments*. Manson, Ohio: South-Western Publishing, 2001.
[17] Geltner, David and Miller, Norman. *Commercial Real Estate Analysis and Investments*. Manson, Ohio: South-Western Publishing, 2001.

Random error is inherently a part of the private real estate market because the business involves trading unique whole assets, assets that are infrequently and irregularly sold through time, and deals are often privately negotiated between one buyer and one seller. In addition, noise in the real estate market can be attributed to the fact that owners are heterogeneous which leads to a wide dispersion of Inherent Values [18] because the Investment Value[19] often differs for each investor. For example, consider the following graph which lays out the Investment Value (IV) values for owners vs. buyers of the same asset. As Figure 2 illustrates, those who place higher values on the type of property are more likely to already have an ownership interest in the asset.

Figure 2

Price Gap between Owners vs. Buyers

Owner & Non-owner Inherent Value Frequency Distributions (as of a single point in time)

Value ($/SF)

20

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[18] Inherent Value – Maximum value a given user would be willing (and able) to pay for the subject property, if they had to pay that much for it (or, for a user who already owns the property, the minimum they would be willing to sell for it), in the absence of any consideration of the market value ("exchange value") of the property.

[19] Investment Value – Inherent value for the non-use (a "landlord"), i.e. , for an investor.

[20] Geltner, David and Miller, Norman. *Commercial Real Estate Analysis and Investments*. Manson, Ohio: South-Western Publishing, 2001.

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One way that random noise can be smoothed out and an asset's Market Value (MV) estimated more accurately is through observing and taking into consideration a large number of transactions. Noise is diminished according to the "Square root of N Rule" which refers to the fact that the standard deviation is proportional to the inverse of the square root of the number of transaction observations used in a value estimate. In order to minimize this noise and maximize the accuracy of their evaluations appraisers use as many comparables (comps) as possible which requires them to go back in time.[21] This dependence on historical values results in an additional type of error not present in purely contemporaneous transaction prices. Referred to as the "temporal lag bias," this error is rooted in the fact that because valuations are based on data in the past, they have a delayed response to changes in market conditions which transaction prices acutely reflect. Thus if we compare an appraised value with a transaction price for the same property as of the same point in time, we are observing the difference between two sets of errors. Transaction prices possess random noise realization but no lag bias. Appraisals contain a systematic lag bias but hopefully a lesser degree of random noise realization.[22]

[21] Fisher, J., M. Miles, and R.B. Webb. "How Reliable are Commercial Appraisals: Another Look." *Real Estate Finance* 16(3), fall 1999.
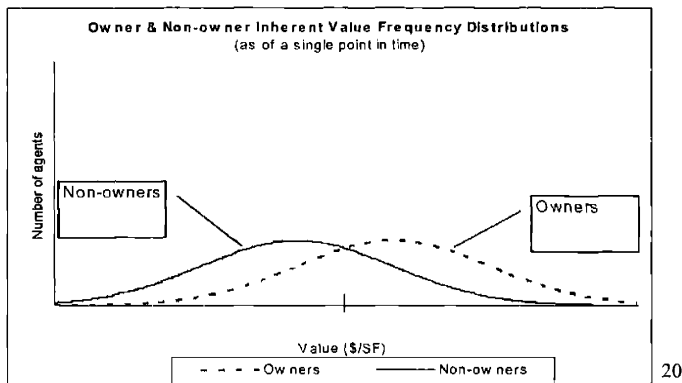[22] Geltner, David and Miller, Norman. *Commercial Real Estate Analysis and Investments*. Manson, Ohio : South-Western Publishing, 2001.

Chapter IV: Research Hypotheses

A) Hypotheses Set One:

The first set of hypotheses in this thesis address some basic questions of the nature of information search and cognitive learning in real estate valuation.

1A) Appraisal and the Prescribed Normative Process

The Appraisal Institute (AI) prescribes the appraisal process as a set of procedures to be used in the valuation of real estate assets. A central part of an appraiser's training involves learning this process.

The theory of representativeness states that decision-makers classify an event or object with others of a certain class-type with which they have experience. This tendency to classify and/or stereotype also leads subjects to organize and store newly received knowledge in their memories in a manner that is greatly influenced by previously learned organizational structures. In other words, the memory structure of newly learned information appears to mirror the format of formerly learned thought processes.[23] Since students of real estate appraisal are taught the appraisal process, their declarative memory organizations should reflect the normative model. Therefore in the absence of task specific requests, declarative memory may serve as a *recipe* to guide appraisal behavior.[24]

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[23] Johnson, E. J., & Russo, J. *The Organization of Product Information in Memory Identified by Recall Times.* In H. Hunt (Ed.), Advance in consumer Research (Vol. 5, pp. 79-86). Chicago: Association for Consumer Research, University of Illinois, 1978.

[24] Diaz, Julian III. *Process Tracing Investigation into Problem Solving Within Residential Real Estate Appraisal.* A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in the College of Business Administration of Georgia State University. 97-98, 1987.

However behavioral research on appraisers has revealed that like many human problem solvers, appraisers have a need for cognitive efficiency to overcome natural informational processing limitations. This need for efficiency leads appraisers to employ subconscious procedures, called "production rules" when valuing properties. Gradually learned over time, production rules end up altering, recombining and even eliminating steps that make up the AI's appraisal procedure. As a result of these alterations, appraisers eventually may come to solve problems in a manner that is quite different from the way in which he or she initially learned how to valuate properties. This is because once in place, production rules are dictatorial in determining routine problem solving behavior.

In an effort to test these two conflicting theories on the influential power of the normative process the first research hypothesis of this thesis is therefore: **1A)** *Real estate appraisers will not solve appraisal problems in a manner that is consistent with the normative model.*

1B) Developers and the Prescribed Normative Process

The prescribed normative process that the AI has developed is by many considered to be a well thought-out, educated way for performing an information search of a property. Because this process was honed from doing years of study on how people should valuate properties it is interesting to see whether or not real world developers follow similar steps. However while this is an interesting comparison to conduct, developers are not expected to follow the AI normative process because unlike appraisers they have not been trained to apply this solution model. Nevertheless, in an effort to

investigate the issues surrounding this comparison the second research hypothesis in this thesis is:

IB: *Real estate developers will not value property in a manner that is consistent with the normative model.*

B) Hypotheses Set Two:

The second set of hypotheses deals with the expected performance of developers versus appraisers in light of the normative model for property valuation.

2A) Comparing Appraisers' and Developers Valuation Behavior

On a common basis a property's appraised value and its market sales price differ in value. Some of this disparity can be accounted to the general condition that real estate (especially in the private markets) is an industry which is informationally inefficient and possesses a great deal of purely random error.[25] However, in the case of appraisals this disparity also appears to be the result of appraisers being extremely dependent on comparable sales prices in their valuations. This reliance on historical values produces something called the "temporal lag bias" which is rooted in the fact that because valuations are based on data in the past, they have a delayed response to changes and shifts in the market. Therefore, because transaction prices acutely reflect and grasp the majority of shifts in the market, there often ends up being a notable difference between a property's appraised value and its sales prices.

In addition it seems that the anchoring heuristic might have the ability to further magnify the gap between an asset's appraisal value and market sales price. As previously

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[25] Geltner, David and Miller, Norman. *Commercial Real Estate Analysis and Investments.* Manson, Ohio: South-Western Publishing, 2001.

explained in Chapter 2, *anchoring* is an adjustment heuristic (or rule-of-thumb) with which humans start with a certain reference point (anchor) and then adjust it insufficiently to reach a final conclusion. In the case of real estate valuation, comparable prices often serve as anchors. Therefore, if appraisers are more dependent on "comps," they put themselves in the position to be more likely arbitrarily influenced by these numbers. This influence can often lead appraisers to come up with a value that is far from the value that the market places on the same asset.

In line with these noted tendencies and their repercussions, the third and fourth research hypotheses of this study are therefore:

IIA) *The valuation behavior of developers and appraisers is not similar.*

IIB) *Appraisers will access a greater number of comparable sales than will developers.*

It has also been speculated that developers and appraisers produce different values because developers are more interested in certain valuation steps which the AI normative valuation model does not include. These missed cues include looking at information on: financing, building prices, market rents, rates of occupancy, subject asking price and development costs. In the experiment administered for this thesis these pieces of information were grouped under Category 8 (non-prescribed steps). In an effort to investigate this theory about developers the fifth research hypothesis of this thesis is:

IIC) *Developers will tend to look at more non-pre-scribed steps such as financing, building prices, market rents, rates of occupancy, subject asking price and development costs than will appraisers.*

Chapter V: Methodology

A) Process Tracing

In order to investigate the hypotheses that are stated in the previous chapter a descriptive research methodology called *process tracing* was employed.

Process tracing methods capture the actual processes used by valuers. While many of the measurement techniques that are wedded to conventional statistics provide statistical precision, they have proven inadequate for tracing and observing decision-making and valuation behavior. The theoretical base for the process tracing tradition was provided by Newell and Simon who illustrated the use of a methodology designed to describe or examine human cognitive processes in problem solving.[26] The tradition aims to describe and explain cognitive problem solving by employing methods that allow the direct observation of problem-solving behavior. Four types of process-tracing methods were developed. These include verbal protocol, information board, eye fixation and information acquisition protocol. These processes allow researches to study how valuers actually do their work by giving them a way to collect evidence about relationships between variables as well as to isolate the impact of key variables.

For the purpose of this study the information acquisition protocol technique was employed. Subjects were asked to estimate the value of a piece of raw land in the Atlanta market. This technique required subjects to request information as needed. A valuer's cognitive process was traced by carefully recording the sequence of the information as it was requested and then utilized.

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[26] Diaz, Julian III. How Appraisers Do Their Work: A Test of the Appraisal Process and the Development of a Descriptive Model. *The Journal of Real Estate Research* 5:1 (Spring, 1990), 2-3.

Jacoby, Chestnut, Weigel and Fisher developed a process statistic for experiments whose purpose is to gain insight into information search and problem solving procedures that subjects employ. Their technique was based upon building models of "transitions." A transition was defined as the change from one acquired information cue to another. In other words, every time a subject requested an additional piece of information during the testing procedure it signified that they were moving from one step to the next.

A similar transition testing model can be used to represent the solution processes that are employed when valuing real estate. The normative valuation model (formally developed by AI) prescribes the solution path to be taken in solving appraisal problems. In the United States, appraisers are trained to value property using the AI's step by step model. First the appraiser defines the appraisal problem by identifying the location of the property, the pertinent property rights, the date of valuation, the valuation basis, and the appropriate definition of value to be estimated. After getting a handle on this information the appraiser is taught to consider general forces which may influence the property value. These general forces can include regional, county, city and neighborhood factors. This process is essential deductive because the appraiser is taught to start with the broadest elements of influence and work down to the most narrow. [27] [28]

As an appraiser moves through the process he or she begins to focus in on the details of the subject. Here the appraisal process calls for the collection of information about the subject's plot, building title, property taxes and zoning. Next the appraiser makes an effort to determine the Highest and Best Use for the property as well to collect

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[27] Diaz, Julian III. How Appraisers Do Their Work: A Test of the Appraisal Process and the Development of a Descriptive Model. *The Journal of Real Estate Research* 5:1 (Spring, 1990), 2.
[28] American Institute of Real Estate Appraisers. *The Appraisal of Real Estate*. Chicago: Author, eight edition, 1987.

comparable data that will support the valuation. This data typically includes comparable sales data, comparable rent data, and comparable cost data.[29]

Because this study is specifically interested in the valuation of raw land (as opposed to existing buildings) as well as analyzing the information search behavior of both appraisers and developers, some additional steps were added to the AI's normative model which is outlined above. After gathering information on the general valuation tendencies of land developers Category 3, (titled Neighborhood Data) was expanded to include additional steps such as description of subject property, subject plat, subject photos and protective covenants and zoning. In addition a whole new category, titled non-prescribed steps, was incorporated. The cues in this category included financing, building prices, market rents, rates of occupancy, subject asking price and development costs. While the normative model ignored these steps it appears that the majority of developers naturally incorporate such steps into their valuation processes. Through adding the steps described above a common developer/appraiser model was created to represent a prescribe solution path that could be used in this study to benchmark and analyze each subject's valuation processes (see Figure 3 for normative developer/appraiser model that was applied).

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[29] Diaz, Julian III. How Appraisers Do Their Work: A Test of the Appraisal Process and the Development of a Descriptive Model. *The Journal of Real Estate Research* 5:1 (Spring, 1990), 2.

Figure 3 -Prescribed Developer/Appraiser Solution Sequence Model

Step Number	Step Description	Transition
1	Problem Definition	
1a	Location of Real Estate to be Valued (Subject Property)	--
1b	Date and Objective of the Appraisal	0
2	General Data	
2a	Neighborhood Location	1
2b	Neighborhood Access	0
2c	Neighborhood Land Uses	0
2d	Neighborhood Economic Outlook	0
2e	Neighborhood Map	0
3	Subject Property Data	
3a	Description of Subject Property	1
3b	Subject Plat	0
3c	Subject Photos	0
3d	Protective Covenants and Zoning	0
3e	Title to the Subject Property	0
3f	Subject Property Taxes	0
4	Highest and Best Use	1
5	Comparable Data	
5a	Land Sales 1, 2, 3 with Photographs and Map	1
5b	Land Sales 4, 5, 6 with Photographs and Map	0
5c	Land Sales 7, 8, 9 with Photographs and Map	0
5d	Land Sales 10, 11, 12 with Photographs and Map	0
6	Valuation Analysis	
6a	Sales Comparison Approach	1
7	Reconciliation and Final Value Judgment	1
8	Non-prescribed Steps	
8a	Financing	-8
8b	Industrial Building Prices	-8
8c	Market Rents for Industrial Buildings	-8
8d	Rates of Occupancy for Industrial Buildings	-8
8e	Subject Asking Price	-8
8f	Development Costs	-8

Normative Appraisal Process

Transition Value	Number of Values	Transition Value	Number of Values	Transition Value	Number of Values	Transition Value	Number of Values
-15	0	-9	0	-3	0	3	0
-14	0	-8	6	-2	0	4	0
-13	0	-7	0	-1	0	5	0
-12	0	-6	0	0	13	6	0
-11	0	-5	0	1	6	7	0
-10	0	-4	0	2	0		

Note: Because subjects "should not" use the non-prescribed steps (8a through 8f), the normative process includes six -8 transition values.

According to the normative model, sub-steps within these larger step categories need not be completed in any prescribed order, but each step should be completed before moving on to the next major category of steps. A total of k-1 transition values exist in a solution process of k steps. According to the systematic solution path mapped out in Figure 3 subjects in this experiment had a total of 23 transition values (-15 to +8) in solution process of 7 steps (including 25 sub steps).[30]

When tracing each subject's decision-making process the following scoring system was employed. Moving from one sub-step to another sub-step within the same step constitutes no transitions and therefore earns a value of zero (i.e. going from 1a to 1b). A transition from one step to the next step in sequence earns a value of 1 (i.e. 5 to 6b or 3b to 4c). On the other hand moving from a step back the step that directly precedes it, earns a value -1 (i.e. 4c to 3d). In addition skipping from a step 5 all the way up to a step 8 earns a transition value of 3, while moving back from step 8 all the way to a step 2 earns a value of -6. Figure 4 illustrates the possible transition values that can be earned when moving from one step to another step within the prescribed model.

Figure 4- Transition Values

Value Earned	Possible Combination of Steps Taken
-7	8 to 1
-6	8 to 2; 7 to 1
-5	8 to 3; 7 to 2; 6 to 1
-4	8 to 4; 7 to 3; 6 to 2; 5 to 1
-3	8 to 5; 7 to 4; 6 to 3; 5 to 2; 4 to 1
-2	8 to 6; 7 to 3; 6 to 4; 5 to 3; 4 to 2; 3 to 1
-1	8 to 7; 7 to 6; 6 to 5; 5 to 4; 4 to 3; 3 to 2; 2 to 1
0	8 to 8; 7 to 7; 6 to 6; 5 to 5; 4 to 4; 3 to 3; 2 to 2; 1 to 1
1	1 to 2; 2 to 3; 3 to 4; 4 to 5; 5 to 6; 6 to 7; 7 to 8
2	1 to 3; 2 to 4; 3 to 5; 4 to 6; 5 to 7; 6 to 8
3	1 to 4; 2 to 5; 3 to 6; 4 to 7; 5 to 8
4	1 to 5; 2 to 6; 3 to 7; 4 to 8
5	1 to 6; 2 to 7; 3 to 8
6	1 to 7; 2 to 8
7	1 to 8

In addition this scoring model also takes into account the steps that are left out. For example if a subject leaves out a sub-step in step category 1 they automatically earn a transition value of -15. Figure 5 illustrates the values that are assigned for missed steps.

Figure 5 – Values for Missed Steps

Transition Value	Missed Stepped
-15	missing 1s
-14	missing 2s
-13	missing 3s
-12	missing 4s
-11	missing 5s
-10	missing 6s
-9	missing 7s
-8	missing 8s

Based on this scoring system if the normative model is followed perfectly, each of the transitions will have a value of 0 (for going from a sub-step within a step to another

sub-step in the same step) or +1(for going from a step to the next step in sequence) or -8 (for not employing non-prescribed steps). If the normative is not followed, the steps that deviate from this model will at least have some values not equal to 0, +1 and/or -8.

After transitions values are gathered up for each subject, the distribution of each of the different transition values is then computed for appraisers and developers. For example, if the group of subjects that are developers have 4 transition values that equal +3 (out of a total of 25 steps) the information recorded for intra-study comparison is : Sixteen percent (4 out of 25 steps) of this subject group's solution path were +3. [31]

Looking at the results from one of the developers that was tested, one can get a better idea of how exactly this scoring process plays out. The following steps make up the valuation process that land developer D-6 exhibited: 2A, 3B, 8E, 5A, 5B, 5C, 4, 8F, 3A, 8C, 3D, 8D, 2B, 8B, 6, 8A, 6, 2D. This solution path can be characterized by the following transition values:1, 5,-3, 0, 0,-1, 4,-5, 5, -5, 5, -6, 6, -2, 2, -2, -4. It is important to note that of the twenty-five prescribed steps, only seventeen end up being taken. Therefore in addition to these transition values D-6 also earned the following values for the steps he missed: -15, -15, -14, -13,-13,-13,-11,-9. In terms of computing the distribution of transition values for D-6's solution path, 12% (3 of 25) were -13; 8% were -5 (2 of 25); 8% were 0 (2 of 25); 8% were -15 (2 of 25); 8% were -2 (2 of 25).[32]

B) The Specific Testing Procedure of this Study

1) Subject Selection - A process tracing experiment was administered in this study to a total of nine developers and ten appraisers. In order to establish a consistent

[31] Diaz, Julian III. How Appraisers Do Their Work: A Test of the Appraisal Process and the Development of a Descriptive Model. *The Journal of Real Estate Research* 5:1(Spring, 1990).
[32] Diaz, Julian III. How Appraisers Do Their Work: A Test of the Appraisal Process and the Development of a Descriptive Model. *The Journal of Real Estate Research* 5:1(Spring, 1990).

pool of subjects that were familiar with the same types of regulatory issues and market trends all of the subjects were required to office in Houston, Texas. In addition, the developers and appraisers who were selected were experts (15 or more years of experience) and had previous experience with purchasing and valuing raw land.

2) **Directions Provided** - The case that the subjects were asked to evaluate focused on a raw piece of industrial land in Atlanta, Georgia. A piece of property was chosen from this area in an effort to present the subjects with a market that they would not be overly familiar with. Subjects were told that the study they were participating in was designed to examine problems in complex business environments. Each subject was instructed to value the selected industrial site and to note that there was no right or wrong answer nor no right or wrong way to arrive at this answer (see Appendix B for Directions).

3) **Materials Provided** - Subjects were then asked to look over a list of folders to decide the information that they would need to value the property (see Appendix B pg. 74, for the list of informational folders). Each was told that they could use as much or as little data as they wished. However, only one data item could be requested at a time and each selected data item had to be returned before the next data item could be obtained. All photographs could be kept until the completion of the task.

In addition, within the case packet a "working copy of a neighbor map" that clearly pointed out the site's location and showed the surrounding area, was provided. Subjects were also encouraged to take notes throughout the valuation process. A blank worksheet was included in the packet specifically to facilitate this purpose.

4) Operational Model – As soon as a subject requested his first piece of information a stopwatch was started. The watch was then stopped when the subject communicated that he did not need to look at any more information because he had established a value for the property. In order to trace the information search of each subject, every time that a subject requested a folder of information the administrator recorded the number that was listed on the folder's tab. Each of these numbers corresponded to a step in the normative process.

Chapter VI: Analysis of Data

A) Introduction to Data Analysis

This chapter presents an analysis of the experimental data and compares these research results with the results required to support the hypotheses articulated in Chapter IV. Testing of the five research hypotheses is followed by a general exploration for significant relationships within the data. Such a-posteriori exploration for significance is referred to as a "fishing expedition"[33] and is characterized by a methodical search of possible relationships that were not considered by the initial hypotheses. Therefore the a-priori hypotheses testing and a-posteriori data exploration are presented separately in the following two sections of this chapter.

B) Examination of Research Hypothesis Set I

Research Hypothesis IA: *Real estate appraisers will not solve appraisal problems in a manner that is consistent with the normative model.*

The variable distribution of transition values was employed to examine hypothesis IA because the appraisal process suggests a normative distribution of transition values. To compare a normative distribution with those of the subjects tested, Kolmogorov-Smirnov one-sample goodness-of-fit tests were conducted.

The null hypothesis for the test procedure is Ho: $Fa(x) = Fo(x)$ (i.e., the true appraiser transition value population distribution is equal to the normative distribution of transition values). The alternative hypothesis for the test procedure is Ha: $Fa(x) < > Fo(x)$.

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[33] Diaz, Julian III. *Process Tracing Investigation into Problem Solving Within Residential Real Estate Appraisal*. A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in the College of Business Administration of Georgia State University, 1987, 130-135.

Therefore rejection of the null hypothesis would serve as evidence to support the research hypothesis. It is also important to note that this thesis employs the typical statistical significance threshold of .05. Therefore this study requires data to give evidence against the null hypothesis that is so strong that it only occurs 5% of the time if Ho is in fact true.[34]

The data set for appraisers was examined yielding a p-value of less than .01, which strongly suggests that the null should be rejected and leads to the conclusion that appraisal behavior was not normative (see Test 1 in Appendix C). Therefore, the empirical results of this research hypothesis serve to support the notion that, like many human problem solvers, appraisers have a need for cognitive efficiency to overcome natural informational processing limitations. This need has led them to deviate from and alter the normative model that they initially learned when training to become appraisers.

Research Hypothesis IB: *Real estate developers will not valuate property in a manner that is consistent with the normative model.*

As with hypothesis IA, the distribution of transition was employed to examine hypothesis IB. Kolmogorov-Smirnov one-sample goodness-of-fit tests were again conducted. Rejection of the null hypothesis would be evidence against the statement that the true distribution of transition values for developers is equal to the normative distribution.

Examining the transition values of developers revealed a p-value of less than .01 (see Test 2 in Appendix C). This low p-value crosses the typical threshold of statistical

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[34] Weiss, Neil A.. *Introductory Statistics*. Boston, Massachusetts: Addison Wesley, 2002.

significance (.05) and offers strong evidence that the null hypothesis should be rejected and leads to the conclusion that developer behavior was non normative.

C) Examination of Research Hypothesis Set II

Research Hypothesis IIA: *The valuation behavior of developers and appraisers is not similar.*

As with the first set of hypotheses, the distribution of transition values was employed to examine hypothesis IIA. Kolmogorov-Smirnov one-sample goodness-of-fit tests were again conducted. The null hypothesis for the test procedure is Ho: $Fa(x) = Fd(x)$ (i.e., the true transition value population distribution of appraisers is equal to the true distribution of transition values for developers). The alternative hypothesis for the test procedure is Ha: $Fa(x) < > Fd(x)$. Therefore, rejection of the null hypothesis would serve as evidence to support the alternative hypothesis.

The data set for appraisers and developers were examined yielding a p-value of less than .01 which strongly suggests that the null hypothesis should be rejected and leads to the conclusion that appraisal behavior and developer behavior is not similar (see Test 3 in Appendix C).

One of the main reasons that developers and appraisers exhibit dissimilar decision processes is because they approach the valuation process with different goals. When valuing a property the end goal of appraisers is to establish a value that reflects the average price that they think the piece of land will sell for in the open market. On other hand, when developers value a piece of property they are focused on finding the true investment value of the asset. Also referred to as the inherent value, developers want to

know what is the maximum price that they can pay for a property and still make a profit. For instance, a specific piece of land might be a great deal more valuable to a developer who already owns land that is adjacent to the site for sale. This is because through gaining control of this additional acreage the present developer will be able to protect the value of his existing asset. In addition, the acquisition of additional space might enable the developer to create a more significant and desirable product than if the two lots were owned and developed on a separate basis.

Research Hypothesis IIB: *Appraisers will access a greater number of comparable sales than will developers.*

The search for comparable sales data (steps 5A, 5B, 5C, 5D) constitutes an important step in solving valuation problems. It has been speculated that appraisers tend on average to look at more comps than developers when valuing a given property. A parametric test of equal population proportions was administered in order to investigate if appraisers' valuations are more dependent on comps. A population proportion is the proportion (percentage) of a population that has a specific attribute. The specific attribute in this study was "viewed comparable sale prices." The populations were:

Population 1: The total number of sales available to appraisers.
Population 2: The total number of sales available to developers.

It can be argued that that there are two different ways that the population pool can be defined. One argument is that this pool should include all of the possible comparable sales that were available for subjects to view. Using this definition, the population for

appraisers is 120 sales (10 appraisers tested times 12 sales available per test) and for developers it is 105 (9 developers tested times 12 sales available per test). The other argument is that because the 12 sales were categorized and presented in 4 folders holding information on 3 sales, the actual population pool should be 40 sales for appraisers (10 appraisers times 4 folders available) and 36 for developers (9 developers times 4 folders available). While the first definition gives us a larger and therefore more statistically attractive population pool with which to work, we cannot be sure if subjects would have requested more or less sales info if this information had been presented on an individual basis instead of in grouped folders. For example, instead of asking to view all four folders (a total of 12 comps) a subject might have cut the process off after viewing just 10 sales. Therefore, in order to be statistically correct and take these issues into account, two different population proportion tests were performed in order to test hypothesis IIB.

First, the population proportion test was computed based on the notion that each sale should be considered to be an individual member of the population. Out of a population of 120 sales the appraisers chose to look at 105, which equal a sample proportion of .875 (87.5%). In regards to developers, out of a population of 108 sales they choose to view 81 which equal a sample proportion of .750 (75.0%). Together, the data produces a test statistic of 2.4 and a p-value of .0082. At the 5% significance level, we have strong evidence which suggests that the null hypothesis should be rejected supporting the position that appraisers look at more sales data than developers and that their valuations my therefore be more dependent on historical sales data (see Test 4 in Appendix C "By Number of Sales").

Secondly, the population proportion test was computed based on the notion that each comparable sales folder should be considered to be a member of the population. Out of a population of 40 sale folders the appraisers chose to look at 35, which equal a sample proportion of .875 (87.5%). With regards to developers, out of a population of 36 sales they choose to view 27, which equal a sample proportion of .750 (75.0%). These results produce a test statistic of 1.4 and a p-value of .0808. At the 10% significance level (as opposed to the 5%), we have evidence which suggests that the null hypothesis should be rejected lending support the position that appraisers look at more sales data than developers and that their valuations my therefore be more dependent on historical sales data (see Test 4 in Appendix C "By Number of Grouped Sales").

While at different levels of significance, these test results confirm the notion that appraisers are more influenced by data in the past than are developers. Evidence of this reliance supports the argument that one of the reasons that there is a gap between appraisal values and market prices is the "temporal lag bias." The temporal lag bias argues that because appraisal valuations are so focused on comparables, they often end up being "stale" for they do not reflect the most current shifts and changes in the market.

Research Hypothesis IIC: *Developers will tend to look at more non-prescribed steps such as financing, building prices, market rents, and rates of occupancy, subject asking price and development costs than will appraisers.*

It was also speculated that the information search behavior of developers and appraisers would differ through the fact that developers routinely take certain steps which the AI normative valuation model does not include. In the experiment administered for

this thesis these cues are grouped under Category 8 which is titled "non-prescribed steps."

As with hypothesis IIA, a parametric test of equal population proportions was administered. The specific attribute in this study was "viewed non-prescribed steps." The populations were:

Population 1: All non-prescribed steps that appraisal subjects could have taken.

Population 2: All non-prescribed steps that developer subjects could have taken.

The results of this test show that the null hypothesis, developers and appraisers take the same number of non-prescribed steps when valuing property, should be rejected. Out of a population of 60 possible non-prescribed steps, the appraisers chose to look at 35, which equal a sample proportion of .583 (58.3%). In regards to developers, out of a population of 54 non-prescribed steps they chose to view 45, which equal a sample proportion of .833 (83.3%). This produces a test statistic of 2.9 and a p-value of .0019. At the 5% significance level, we have very strong evidence that suggests that appraisers take fewer non-prescribed steps than developers (see Test 5 in Appendix C).

This empirical data backs up the notion that developers are focused on establishing the Investment Value (IV) of an asset when valuing a property. In order to establish an asset's IV a developer needs to have a clear sense of the property's potential income stream. This can only be calculated by analyzing and projecting the project's potential occupancy rates and market rents (steps 8c and 8d valuation model). After establishing

the potential revenue of the project, the developer then evaluates the costs associated with the project. This process includes evaluating information on the subject's asking price, and relevant construction costs, as well as on the current lending climate (steps 8f, 8e and 8a in the valuation model). If an investor concludes that a project's costs exceed its benefits, then value of the project to the investor would be zero even though the property may sell on the open market for a positive price.

The fact that developers are more focused on the IV of a project is reflected in that a notable number of the developers, who were interviewed for this study, refused to put a final value on the property. In contrast, all of the appraisers that were tested ended their information search with a numerical estimation of the property's price. The developers who refused to put a final value on the property specifically explained that the piece of land that they had been presented with, would not be something that they would move forward on for they believed that the asset had an IV of zero.

D) Summary of A-priori Statistical Results

All five of the research hypotheses in this study were supported by the experimental evidence. Appraisal behavior was found to be non-normative. The majority of appraisers take certain cognitive shortcuts that end up altering the normative model when valuing an asset.

Developer behavior also proved to be non-normative. These results seem to support the notion that the normative model that has been developed to value real estate is not congruent with the majority of natural decision processes actually employed in the field.

The information search behavior of appraisers and developers was found to be observably different. This finding seemed to result from the fact that developers and appraisers approach the valuation process with different goals. While the value that appraisers estimate is to reflect the price that the property will sell for in the market, the value that a developer puts on a property represents the value that the asset holds for them on an individual basis.

Appraisers were found to look at more comparables than were developers. This empirical evidence bolsters the argument that one of the reasons that there is a gap between appraisal values and market prices is the "temporal lag bias."

In addition, the informational search behavior of developers and appraisers differed in that developers tended to take more steps that are not included in the normative model. The fact that developers feel a strong need to look at cost related information such as financing, the subject's asking price and development costs, as well information that will help them to gauge the size of the property's future revenue stream, such as market rents, rates of occupancy, and building prices, supports the theory that developers are focused on finding the IV of a property. This is because in order to establish the IV of a property, each land developer must figure out if the benefits of the property outweigh the costs for them as an investor.

E) Development of Descriptive Models

While less definitive than statistics, the descriptive modeling of actual decision-making processes can yield valuable insights. The flow charts displayed in Figure 5 and 6 illustrate the general processes that developers and appraisers typified in this experiment.

The order of groupings represents common tendencies of subjects and the steps within groupings are placed in general order accessed by subjects. Next to each step is a percentage which shows the proportion of subjects, who decided to take a particular step. There is also a section dedicated to providing information on the steps that the subjects tended not to take on a routine basis.

Through looking at Figure 5 one sees that the appraiser model is a five-step process: 1) problem definition, 2) gathering subject property information, 3) gathering general market information, 4) gathering market data and 5) final judgment. It is non-normative and represents appraisers' tendency to deviate from the rather lengthy, complex normative model in favor of an abbreviated process.

In addition, the prescribed normative appraiser model is essentially deductive, beginning with the most general data (i.e. neighborhood location and land uses) and narrowing its focus gradually to the specifics of the subject (i.e. zoning, subject plat). However, looking at the descriptive model of appraiser processes we see that the actual process that is employed is inductive. The model shows that subjects moved from the specifics of the problem definition to the specifics of the subject property and only broaden their inquiry after this information is received.[35]

Looking at Figure 6 we are able to gain insight into the decision processes of developers. While appraisers approached the valuation process with the notion that their purpose is to estimate a definitive value for an asset, developers enter into the process with the attitude that they are evaluating and testing the property as a potential deal candidate. This evaluative attitude leads the developers to set up their information search

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[35] Diaz, Gallimore and Levy. Residential Valuation Behavior in the United States, the United Kingdom and New Zeland. *Journal of Property Research*. 19:4 (March, 2002).

as a series of screens that the property must pass before the developer continues on with the process. The model shows that the first screen developers employ involves obtaining a general sense of what the property looks like by accessing pieces of information like the subject plat, the subject description and the highest and best use for the site. If developers are satisfied with what they see at this level they then move on and begin to familiarize themselves with the market. This involves understanding the current market rents, rates of occupancy and development costs for similar buildings. The third test consists of looking at the economic outlook for the asset by gathering information on such things as the lending environment, industrial building prices and comparable land sale prices. If a piece of property makes it through this series of tests, then and only then will the developer place a value on the asset.

Figure 6 - Appraiser Model

Define the Problem
1b date/objective (90%)

↓

Gather Subject Property Information
3a subject description (90%)
1a subject location (60%)
3c subject photos (70%)
4 highest and best use (90%)
3d covenants and zoning (70%)
3b subject plat (60%)
3e subject title (70%)
3f subject taxes (70%)

↓

Gather General Market Information
8c market rents for buildings (60%)
2c neighborhood land uses (70%)
2d area economic outlook (90%)
8d rates of occupancy (70%)

↓

Gather Market Data
8e subject asking price (90%)
5 comparable land sales
    1st three sales (100%)
    2nd three sales (90%)
    3rd three sales (80%)
    4th three sales (80%)

↓

Final Value Judgment
7 reconciliation, final judgment (100%)

The Descriptive Valuation Process of Appraisers

Order of groupings represents general tendencies of subjects

Steps within groupings are placed in order generally accessed by subjects

Criteria for including a step in model:
  Step employed by more than 50% of subjects

Steps not included in Appraiser model:
  2a neighborhood location (50%)
  2b neighborhood access (50%)
  2e neighborhood map (40%)
  8a financing (30%)
  8b industrial building prices (50%)
  8f development costs (50%)

Figure 7- Developer Model

```
┌─────────────────────────────────────────┐          ┌──────────────────────────────────────┐
│  Gather Subject Property Information     │          │      The Descriptive Valuation       │
│  8e subject asking price (100%)          │          │      Process of Developers            │
│  3a subject description (100%)           │          │                                      │
│  4 highest and best use (67%)            │          │  Order of groupings represents       │
│  3b subject plat (78%)                   │          │  general tendencies of subjects      │
│  3d covenants and zoning (67%)           │          │                                      │
└─────────────────────────────────────────┘          │  Steps within groupings are placed in│
                    │                                 │  order generally accessed by subjects│
                    ▼                                 │                                      │
┌─────────────────────────────────────────┐          │  Criteria for including a step in    │
│  Gather General Market Information        │          │  model:                              │
│  8c market rents for buildings (89%)     │          │    Step employed by more than 50%    │
│  8d rates of occupancy (89%)             │          │    of subjects                       │
│  8f development costs (67%)               │          │                                      │
└─────────────────────────────────────────┘          │  Steps not included in Developer     │
                    │                                 │  model:                              │
                    ▼                                 │    1a subject location (44%)         │
┌─────────────────────────────────────────┐          │    1b date/objective (44%)           │
│  Gather Market Data                      │          │    2a neighborhood location (44%)    │
│  5 comparable land sales                 │          │    2b neighborhood access (44%)      │
│        1st three sales (100%)            │          │    2c neighborhood land uses (44%)   │
│        2nd three sales (89%)             │          │    2d area economic outlook (44%)    │
│        3rd three sales (55%)             │          │    2e neighborhood map (22%)         │
│        4th three sales (55%)             │          │    3c subject photos (33%)           │
│  8a financing (78%)                      │          │    3e subject title (33%)            │
│  8b industrial building prices (78%)     │          │    3f subject taxes (22%)            │
└─────────────────────────────────────────┘          │                                      │
                    │                                 │                                      │
                    ▼                                 └──────────────────────────────────────┘
┌─────────────────────────────────────────┐
│  Final Value Judgment                    │
│  7 reconciliation, final judgment (78%)  │
└─────────────────────────────────────────┘
```
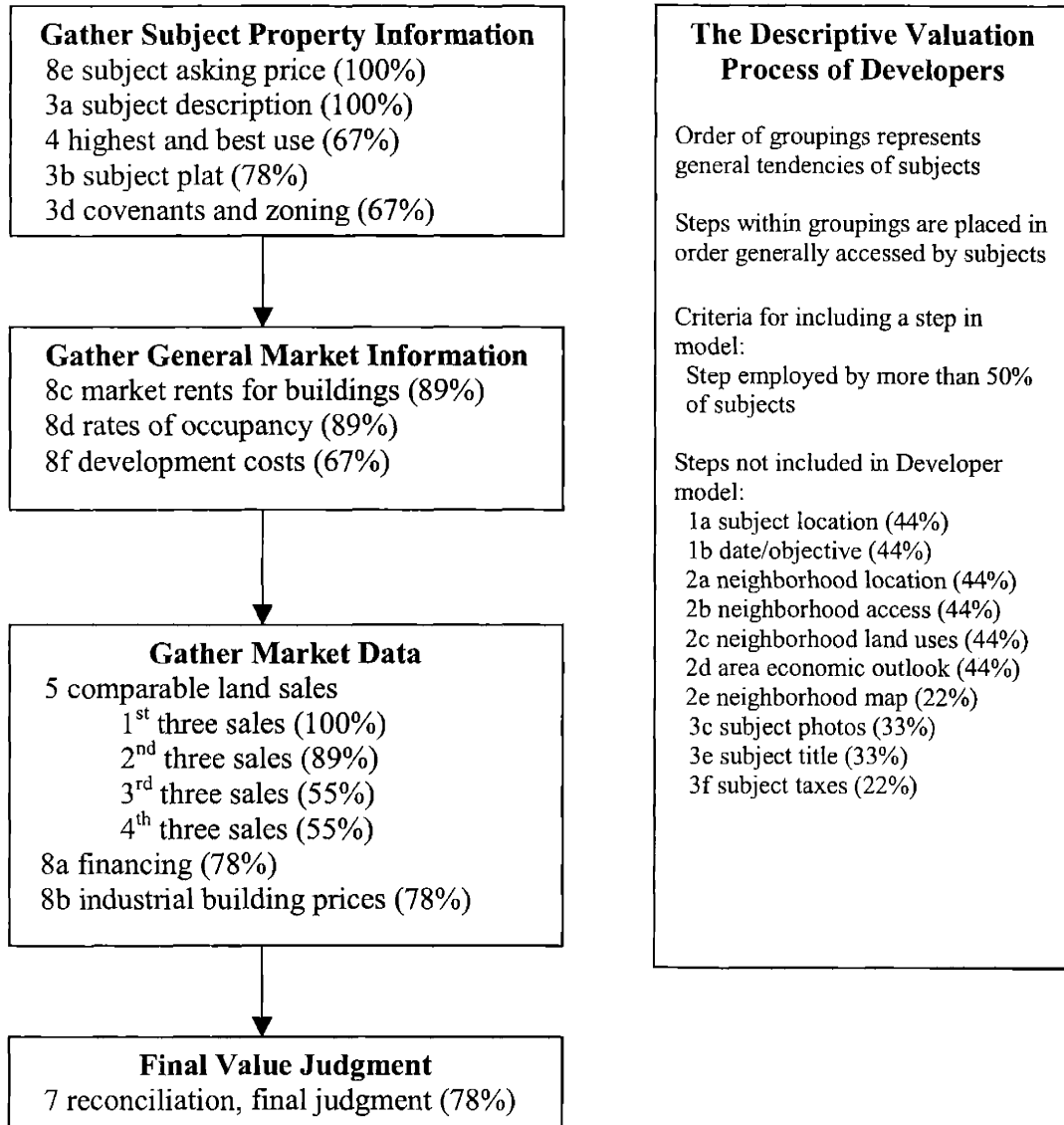
F) A-posteriori Results

An a-posteriori search for significant relationships was conducted. The central element investigated was the role that a developer's exit strategy plays in shaping his or her valuation process. The land developers in this study can be divided up into the two camps of: 1) Speculative Players and 2) Land to Building Developers. Speculative Players are those who invest in raw land, hold it for a period of time and then hopefully sell it again for a profit as soon as the market is ready to pay a premium for it. The profit-gain that these developers are able to obtain fundamentally comes from these individuals' investment foresight. Land Speculators make their money by seeing the potential of an area or piece of raw land before the market does as well as often having the stamina to hold on to this land until it is ripe for development.

Land to Building Developers buy land with a different strategy in mind. These individuals buy land with the intention of eventually developing it themselves. The value that these developers add is fundamentally tied to the physical building improvements that they add to the land and their ability to gauge the property-type that fits the property's character and surrounding market conditions.

Two major tendencies become obvious through comparing the informational search behavior of these two camps. First, Land to Building Developers tend to be more interested in looking at the development costs of the project. While the development cost might eventually influence the price for which a Speculative Player will be able to sell his property, this element more directly impacts a Land to Building Developer's investment. Secondly, Land to Building Developers are more interested in looking at the lending terms that are attached to the deal. Speculative Players have found it more plausible and beneficial to fund their deals with equity rather than debt, as to even pay cash for an

asset.[36] Since speculative investments are considered to be quite risky, the interest rates that lenders charge is so high that obtaining debt financing for such deals often becomes unattractive. In addition, because raw land does not produce a current income stream, debt service payments are only that much more daunting.[37]

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[36] Jon Runstad, Chairman and Chief Executive Officer, Wright Runstad & Company, *Interviewed Via Telephone on May 18, 2003.*

[37] David Wolff , Chairman and President, Wolff Companies, *Interviewed In Person on July 18, 2003, Nantucket, MA.*

Chapter VII: Conclusions

Investigating real world problems associated with valuing raw land raises questions about current valuation practices. In particular, the results indicate that true appraisal behavior deviates from the normative model and that the valuation behavior of developers is significantly different from that of appraisers. This raises serious questions about the efficacy of the AI's current methodology.

The disparity that exists between the processes that land developers use to value an asset and the tactics that appraisers employ is extremely perplexing for the following reason. In reality, the buy and sell decisions that land developers and investors make, define the market. The job of appraisers is to estimate the most likely sales price that a subject's property will sell for in the market. Therefore, if notable disparities continue to exist between appraisers' and developers' valuations, appraisers' property estimates will be seen as erroneous and irrelevant and therefore end up being ignored.

Because real estate is an industry that is fraught with informational inefficiency and "noise," an element of random error will always exist in property price estimates. Nevertheless, through rethinking the AI's model and the current appraisal practices that are in place, the gap between appraisal values and market land prices can be reduced. While rethinking and altering the AI model is a difficult process, if this task is not undertaken appraisers run the risk of their valuations becoming marginalized. The descriptive models illustrated in this thesis for both the appraiser and developer thought process offer a starting point for thinking about where the current AI model is flawed and, possibly, what additional steps it should consider incorporating. In particular, the AI model should take into consideration certain aspects which land developers typically

analyze when determining the Investment Value of an asset. These include being more concerned with information on the subject's asking price, development costs and financing. In addition, appraisers should proceed cautiously when formulating their valuations around comparables. Specifically, because real estate is such a vacillating, volatile business, with so many elements that can affect an asset at different times within the cycle, appraisers should realize that comparables can quickly become irrelevant in establishing the current value of an asset. While comparables are a necessary part of the valuation process, appraisers must realize that they represent only part of the investment picture.

Chapter VIII: Future Directions

Certain focal questions and issues emerge from this study. First, it is important to note that observations of this study are preliminary and require validation. Because only nine land developers and ten appraisers participated in this study questions arise such as how robust are the descriptive models of developer and appraiser behavior across subjects and tasks. Can these two information search strategies be generalized for both of these descriptive fields? Only through conducting additional experiments can these questions be answered.

The information search behavior of developers is one area for which this thesis opens the door for further research. While the informational processing behavior of developers with different exit strategies was investigated, it would also be interesting to look into how a developer's entry point might affect the structure of this process. Specifically, are there notable differences between the decision processes that owners versus potential buyers employ when estimating the value of a property? While it has been observed that owners typically place higher values on assets it would be interesting to investigate the differences between the processes that these individuals employ in order to establish their final values.

Appendix A

Atlanta Case

Location of the Real Estate to be Valued (Subject Property)

Location: West side of Vaughn Road 490 feet north of Roberts Boulevard

District, Land Lot: 20th District, 2nd Section, Land Lot 173

County, State: Cobb County, Georgia

Land Area: 4 acres

Date and Objective of the Appraisal

The objective of this appraisal is to estimate the market value of the fee simple interest of the above identified property as of June 2, 2003, the most recent date of inspection.

Neighborhood Location

The subject property is situated approximately 22 air miles northwest of the Atlanta Central Business District. More specifically, the subject is located in Land Lot 173 of the 20th District, 2nd Section of Cobb County, Georgia in the north central section of the county.

The subject neighborhood, as indicated on the neighborhood map following this discussion, may be generally delineated by the following area boundaries:

City of Kennesaw to the northwest,

Interstate 75 to the east,

The CSX Rail Line to the west and south.

Neighborhood Access

Access to the subject neighborhood is considered good from downtown Atlanta and other locations in the metropolitan area. Traversing the neighborhood from northwest to southeast are US Highway 41 (Cobb Parkway) and Dixie Highway (Old US Highway 41). McCollum Parkway and Ernest W. Barrett Parkway serve in a southwest/northeast direction. There are all multiple-lane, well maintained, heavily utilized highways. Access to I-75 is via Big Shanty Road and Ernest W. Barrett Parkway. Both intersections are located within three miles of the subject property. I-285, the Atlanta perimeter highway, is twelve miles to the southeast and links the subject with all major points of interest in the metropolitan Atlanta area as well as to the nation's interstate highway system.

Neighborhood Land Uses

Development in the immediate subject area is primarily oriented toward commercial and light industrial land uses, but heavy industrial as well as residential uses are represented. The subject neighborhood is estimated to be approximately 60% built-up. Good levels of maintenance and physical appearance typify the subject area.

Primarily commercial development is located along Cobb Parkway and Ernest W. Barrett Parkway and consists of retail and some service oriented uses. Major commercial development is represented by Town Center at Cobb, a regional mall located at I-75 and Ernest W. Barrett Parkway. Other points of interest include the Barrett Industrial Area, the Kennesaw Mountain National Battlefield Park, McCollum Airport, Pinetree Country Club and Kennesaw State University all located within a five mile radius of the subject property.

The neighborhood possesses an above average complement of public, educational, and recreational facilities. Accessibility to public transportation, medical facilities, neighborhood shopping centers, areas of major employment, and other supportive services is typical of similar socio-economic areas.

Neighborhood Economic Outlook

Consistent economic growth has characterized the subject area and is expected to continue to do so. A strong employment base is present. I-575, I-75 and I-285 provide good access to all metro Atlanta destinations. No adverse neighborhood conditions are noted.

Description of Subject Property

The subject property is an industrial site. The rectangular shaped parcel contains approximately 4.0 acres. Road frontage includes some 357.14 feet along the west side of Vaughn Road, a 60 foot right-of-way.

The site is at road grade rising gently and generally exhibiting an overall level topography. At the subject property, Vaughn Road is a two-lane, asphalt paved roadway which is improved with concrete curbs, gutters, and storm drains. Site ingress and egress are typical for the area.

Presently there are no easements, encroachments or hazardous materials which encumber the site. The subject is not located in a flood hazard zone. Police and fire protection are provided to the subject. Public utilities available include electricity, water, sanitary sewer, and natural gas.

Based on the subject's functional shape, level topography, accessibility, frontage and exposure the site is considered to possess good overall physical utility for land uses consistent with those prevalent in the neighborhood and is judged to require minimal preparation.

Protective Covenants and Zoning

The property is under the jurisdiction of Cobb County and is currently zoned LI, Light Industrial. This classification permits office/warehouse type development. There are no protective covenants or deed restrictions associated with the subject property.

Title to the Subject Property

Title to the subject property is vested in IFA Properties by virtue of deed from Raymond and Lillian Whitman dated November 25, 2000 recorded in deed book 4235 page 87 of Cobb County, Georgia record. There are no liens or encumbrances on the property including deed restrictions or protective covenants.

Subject Property Taxes

The subject property is under the ad valorem taxing authority of Cobb County, Georgia. The property is assessed at 40% of market value which the county has estimated to be $300,000. The current tax rate is $42.75 per thousand dollars of assessed value. Taxes are due by October 1 and are not currently delinquent.

Highest and Best Use

Based on consideration of the physical, legal, and market conditions of the subject property and the surrounding neighborhood, the highest and best use of the subject property is judged to be a light industrial, office/warehouse facility of moderate to good quality.

Comparable Land Sales 1, 2, 3

Land Sale Number	1	2	3
Location	1300 Cobb International Boulevard	4000 Cobb International Boulevard	955 Cobb Place Boulevard
Sale Price	$361,000	$418,500	$742,400
Financing	Cash to Seller, Typical Terms	Cash to Seller, Typical Terms	Cash to Seller, Typical Terms
Date of Sale	September 10, 2002	March 29, 2001	November 13, 2002
Tract Size	4.502 acres	4.728 acres	8.734 acres
Price/Acre	$80,187	$88,515	$85,001
Zoning	LI, Light Industrial	LI, Light Industrial	LI, Light Industrial
Deed Restrictions	None	None	None
Remarks	Currently vacant and for sale at $90,000 per acre; site is level and cleared and enjoys good access, all utilities available	Subsequent to sale site was improved with a two occupant light industrial building; site has good access, required minimum site preparation, all utilities available	100,000 square foot office/ warehouse currently under construction on the site; property has good access; typical site preparation required, all utilities available

Comparable Land Sales 4, 5, 6

Land Sale Number	4	5	6
Location	2300 Barrett Park Drive	2100 Barrett Park Drive	Airport Road at Barrett Park Drive
Sale Price	$460,200	$382,200	$365,000
Financing	Cash to Seller, Typical Terms	Cash to Seller, Typical Terms	Cash to Seller, Typical Terms
Date of Sale	May 14, 2002	October 1, 2002	April 22, 2003
Tract Size	5.113 acres	4.684 acres	4.2 acres
Price/Acre	$90,006	$81,597	$86,905
Zoning	LI, Light Industrial	LI, Light Industrial	LI, Light Industrial
Deed Restrictions	None	None	None
Remarks	Vacant, generally level and cleared, minimal site preparation required, good access, all utilities available	Vacant, level, and cleared; site has good access, minimum site preparation required, all utilities available	Vacant, generally level and cleared, minimal site preparation required, good access, all utilities available

Comparable Land Sales 7, 8, 9

Land Sale Number	7	8	9
Location	2225 Barrett Park Drive	1811 Doc Green Road	175 Big Shanty Road
Sale Price	$546,000	$700,000	$270,000
Financing	Cash to Seller, Typical Terms	Cash to Seller, Typical Terms	Cash to Seller, Typical Terms
Date of Sale	June 3, 2001	March 18, 2003	August 12, 2001
Tract Size	6.5 acres	8.73 acres	3.2 acres
Price/Acre	$84,000	$80,183	$84,375
Zoning	LI, Light Industrial	LI, Light Industrial	LI, Light Industrial
Deed Restrictions	None	None	None
Remarks	Vacant, level, and cleared; site has good access, minimum site preparation required, all utilities available; subsequent to sale, property improved with local fire station	Vacant, wooded, gently rolling site with good access, some site preparation required, all utilities available	Vacant, level, cleared, slightly below road grade; good access; in older industrial area; minimum site preparation required; all utilities available

Comparable Land Sales 10, 11, 12

Land Sale Number	10	11	12
Location	220 Big Shanty Road	Vaughn Road at Cobb Place Boulevard	1695 Doc Green Road
Sale Price	$525,000	$375,000	$432,000
Financing	Cash to Seller, Typical Terms	Cash to Seller, Typical Terms	Cash to Seller, Typical Terms
Date of Sale	November 12, 2001	September 10, 2002	July 21, 2001
Tract Size	6.1 acres	4.25 acres	5.33 acres
Price/Acre	$86,066	$88,235	$81,051
Zoning	LI, Light Industrial	LI, Light Industrial	LI, Light Industrial
Deed Restrictions	None	None	None
Remarks	Vacant, level with road grade, wooded; good access; in older industrial area; minimum site preparation required; all utilities available	Vacant, level, and cleared; corner site with good access, minimum site preparation required, all utilities available	Vacant, wooded, gently rolling site with good access, some site preparation required, all utilities available

Financing

The subject property may be purchased on terms from the owner. The owner is willing to take back a purchase money mortgage and to subordinate it to a development lender. Terms are negotiable, but the owner is looking for a 20% down payment with an interest rate at 1 or 2 points above prime and payments based on a 7 to 10 year term.

Development financing is available from local lenders at 2 or 3 percentage points above prime.

Development Costs

Typical hard development costs in the subject area are $30,000 to $35,000 per acre which includes grading/clearing, paving, storm sewers, sanitary sewers, utilities, and landscaping. Soft costs (engineering, overhead, public approvals, legal and accounting, interest, and fees) generally total around $20,000 to $25,000 per acre.

Rates of Occupancy for Industrial Buildings

Current rates of occupancy for light industrial and office/warehouse facilities in the subject area are 85% to 90%.

Market Rents for Industrial Buildings

Rents for light industrial and office/warehouse buildings in the subject area range from about $3.50 to $4.00 per square foot of building.

Industrial Building Prices

Light industrial and office/warehouse buildings in the subject area sell for about $28.00 to $35.00 per square foot of building.

Subject Asking Price

The subject property is currently for sale at $90,000 per acre or a total of $360,000.

Appendix B

<u>Instructions Provided</u>

This study is designed to examine problem solving in complex business environments. You will be asked to value an industrial site in Atlanta Georgia based on information supplied to you. Note that there is no right or wrong answer, no right or wrong way to arrive at an answer. You should complete the task expeditiously, but you have as much time as you desire.

Please begin by answering the following questions. Note that these items are for demographic purposes only and are optional. If you decide to complete these demographic items, rest assured that your anonymity will be preserved. Thank you for your participation.

AGE_____   GENDER_____

EDUCATION:

Degree_____   Year of Degree_____

Degree Granting Institution_____

EXPERIENCE:

Total Years Real Estate Experience_____

Years Experience in Appraisal_____   in Development_____

Years Real Estate Experience in Houston_____   in Atlanta_____

PROFESSIONAL REAL ESTATE DESIGNATIONS OR AFFILIATIONS

_____

_____

PLEASE TURN THE PAGE

Please look over the list below to decide what information you desire to value the property. You may use as little or as much of the data as you wish. Only one item on the list may be requested at a time. Take as much time and as many notes as you wish. Please return the selected data item before the next data item you desire is given to you. All photographs may be kept until the completion of the task. The order of data selection is up to you.

_____ Date and Objective of the Appraisal

_____ Description of Subject Property

_____ Development Costs

_____ Financing

_____ Highest and Best Use

_____ Industrial Building Prices

_____ Land Sales 1, 2, 3 with Photographs and Map

_____ Land Sales 4, 5, 6 with Photographs and Map

_____ Land Sales 7, 8, 9 with Photographs and Map

_____ Land Sales 10, 11, 12 with Photographs and Map

_____ Location of Real Estate to be Valued (Subject Property)

_____ Market Rents for Industrial Buildings

_____ Neighborhood Access

_____ Neighborhood Economic Outlook

_____ Neighborhood Land Uses

_____ Neighborhood Location

_____ Neighborhood Map

_____ Protective Covenants and Zoning

_____ Rates of Occupancy for Industrial Buildings

_____ Subject Asking Price

_____ Subject Photos

_____ Subject Plat

_____ Subject Property Taxes

_____ Title to the Subject Property

Scoring Sheet
Subject:
Time/Date:
Location:

Number	Step	Time	Comments
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WORK SHEET

Appendix C

<u>Significance Tests for Research Hypotheses</u>

Research Hypothesis IA) *Real estate appraisers will not solve appraisal problems in a manner that is consistent with the normative model.*

Test 1
Variable: Distribution of Transition Values
Comparison: Appraisers vs. Normative Model

Ho: Fa (x) = Fo(x) (the distribution of transition values for appraisers is equal to that of the normative model)
Ha: Fs(x) < > Fo(x) (the distribution of transition values for appraisers is not equal to that of the normative model)

Result to Support the Alternative Hypothesis: Fail to Reject
Test Statistics: K-S (1), D= 0.33193
Selected Critical Values: D(.01)= 0.105657
P-value: < .01

Research Hypothesis IB: *Real estate developers will not value property in a manner that is consistent with the normative model.*

Test 2
Variable: Distribution of Transition Values
Comparison: Developers vs. Normative Model

Ho: Fd (x) = Fo(x) (the distribution of transition values for developers is equal to that of the normative model)
Ha: Fd(x) < > Fo(x) (the distribution of transition values for developers is not equal to that of the normative model)

Result to Support the Alternative Hypothesis: Fail to Reject
Test Statistics: K-S (1), D= 0.17978
Selected Critical Values: D(.01)= 0.099754
P-value: < .01

Research Hypothesis IIA: *The valuation behavior of developers and appraisers is not similar.*

Test 3
Variable: Distribution of Transition Values
Comparison: Appraiser Valuation Process vs. Developer Valuation Process

Ho: Fa(x) = Fd(x)
Ha: Fa(x) < > Fd(x)

Result to Support the Alternative Hypothesis: Fail to Reject

Test Statistics: K-S (1), D= 0.161914
Selected Critical Values: D(.01)= 0.145308
P-value: < .01

<u>Research Hypothesis IIB:</u> *Appraisers will access a greater number of comparable sales than will developers.*

Test 4

Variable: Number of Sets of Comps Requested for Evaluation

Comparison: The population proportion of sales used by appraisers vs. the population proportion of sales used by developers

H_0: $P_a \leq P_d$ (the population proportion of available sales used by appraisers is
        less than or equal to the population proportion of available sales
        used by developers)

H_a: $P_a > P_d$ (the population proportion of sales used by appraisers is more than
        the population proportion used by developers)

Result to Support the Alternative Hypothesis: Fail to Reject

Test Statistic:

$$Z = (p_a - p_d)/s_{pa-pd}$$

Where $s_{pa-pd} = \sqrt{((p'(1-p'))/n_a) + ((p'(1-p'))/n_d)}$

    p_a = the sample proportion of accessed to available sales for appraisers
    p_d = the sample proportion of accessed to available sales for developers
    $p' = (n'_a + n'_d)/(n_a + n_d)$
    n'_a = the total number of sales accessed by appraisers
    n_a = the total number of sales available to appraisers
    n'_d = the total number of sales accessed by developers
    n_d = the total number of sales available to developers

By number of sales
    $p_a = 105/120 = .875$
    $p_d = 81/108 = .75$
    $p' = .8158$
    $s_{pa-pd} = .0519$
    $Z = 2.4$
    Compare to the Z distribution for a p-value of .0082
    Strong evidence to reject null and support research hypothesis

By number of groups of sales

$p_a = 35/40 = .875$

$p_d = 27/36 = .75$

$p' = .8158$

$s_{pa-pd} = .0893$

$Z = 1.4$

Compare to the Z distribution for a p-value of .0808

Weaker evidence to reject null and support research hypothesis

Research Hypothesis IIC: *Developers will tend to use more non-pre-scribed steps such as financing, building prices, market rents, rates of occupancy, subject asking price and development costs than will appraisers.*

Test 5

Variable: Number of Non-Prescribed Steps taken

Comparison: The population proportion of available non-prescribed steps used by developers vs. the population proportion of available non-prescribed steps used by appraisers

Developers will tend to look at more non-prescribed steps such as financing, building prices, market rents, rates of occupancy, subject asking price and development costs than will appraisers.

Test Hypotheses:

H_0: $P_d \leq P_a$ (the population proportion of available non-prescribed steps used by developers will be less than or equal to the population proportion of non-prescribed steps used by appraisers)

H_a: $P_d > P_a$ (the population proportion of available non-prescribed steps used by developers will be more than the population proportion of non-prescribed steps used by appraisers)

Test Statistic:

$Z = (p_d - p_a)/s_{pd-pa}$

Where $s_{pa-pa} = \sqrt{((p'(1-p'))/n_d) + ((p'(1-p'))/n_a)}$

p_a = the sample proportion of accessed to available non-prescribed steps for appraisers

p_d = the sample proportion of accessed to available non-prescribed steps for developers

$p' = (n'_a + n'_d)/(n_a + n_d)$

n'_a = the total number of non-prescribed steps accessed by appraisers

n_a = the total number of non-prescribed steps available to appraisers

n'_d = the total number of non-prescribed steps accessed by developers

n_d = the total number of non-prescribed steps available to developers

$p_a = 35/60 = .5833$
$p_d = 45/54 = .8333$
$p' = .7018$
$s_{pa-pd} = .0860$
$Z = 2.9$
Compare to the Z distribution for a p-value of .0019
Strong evidence to reject null and support research hypothesis

Result to Support the Alternative Hypothesis: Fail to Reject

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