**Consumer Utility**

We model utility in the following way. Above all the consumer prefers mom-and-pop stores. To account for both his preference and the variability in the market, his utility is a positive constant plus some random factor:

U = (pM + rM(0,1])[[1]](#footnote-1)

The big-box store gives the consumer some utility as well. It does not have the utility of being the preferred place to shop. Therefore the store only gives something of the random variation of the market:

U = (pM + rM(0,1]) + rB(0,1]

The overall utility in the market is expressed as the sum of these utility given for each consumer. To rephrase our thesis: consumers have the most utility when both mom-and-pops and big-boxes are around, they have the second greatest utility when they have only mom-and-pops, and the least utility when they have only big-boxes. It turn out that even in cases of high preference for mom-and-pop store, the consumers’ least preferred outcome results.

**Big-box Statistics**

**Runs**

The following graphs represent the average run time of models where consumer preference for mom-and-pops is 0.0, 0.2, 0.4, 0.6, and 0.8 respectively. All other variables beside preference are held constant.[[2]](#footnote-2) For each preference level, we ran seventy-five runs of seventy-five periods each. Note that in all experiments the big-box store appears in period 20.

**[Graph 1.0] [Graph 1.2]**

**[Graph 1.4] [Graph 1.6]**

**[Graph 1.8]**

Clearly the trend is for environments whose consumers have a “low enough" preference to lose their mom-and-pop stores. In [Graphs 1.0, 1.2, 1.4. and 1.6], the consumer utility was raised by the presence of the big-box store; yet in the end, its presence drove out the mom-and-pops, leaving it in the cases where consumers preferred mom-and-pops to big-boxes where the end result was a net loss in utility.

**Mathematical Analysis**

Consumers begin with their 2nd preference: having the mom-and-pop stores without big-boxes. Once the big-box appears, consumers will have their most desired outcome: namely, both kinds of store. It is sufficient to show that positive consumer preference *for* mom-and-pops is expected to result in the disappearance of mom-and-pops, leaving consumers with their least desired outcome. This upper limit is a pleasant side-result of this analysis.

In our model, if a retailer’s capital falls below zero, it is out of the game. To keep track of funds, we shall represent income and expense by *I* and *E*. In symbols, therefore, before the *big-box* appears, the *mom-and-pop* should be either making due, or making profit:

*IM ≥ E*

The condition our model concerns is where the *B* enters the market, both the *big-boxes* and the *mom-and-pops* operate at a net loss until the *mom-and-pop*s’ run out of funds; namely

(a) *E* *≥ IB ≥ IM*

or

(b) *E* *≥ IM > IB*

Since the *big-box* has an initial storehouse of funds larger than that of the *mom-and-pop*s, condition (a) clearly will lead to the *mom-and-pop*s’ demise and the *big-box*’s success. Condition (b) has this result if and only if the *big-box* doesn’t lose funds too quickly.

Generally speaking, we are looking at the relations

(c) *IB ~E ~ IM*

where the tildes are placeholders for inequity signs.

Let’s understand how our model’s key players factor into the retailers’ incomes: We let *N* stand in place for the number of consumers who shop at retailers, *D* the dollar amount consumers give each store each turn, *G* the number of types of goods (hence the number of *mom-and-pop*s), and *c* the probability a consumer will shop at a *mom-and-pop*. The probability *c* is a function of pM (higher pM is directly proportional to the higher mom-and-pop shopping chances).[[3]](#footnote-3)

Initially, when there are no *big-boxe*s, the expected value for each *mom-and-pop*’s income is the money gotten from all consumers who decide to shop for their good that day. Since the total number of customers for a particular store is divided amongst the *G* goods, a *mom-and-pop*’s expected income is

*IM*= *D* \* (*N / G*)

When a *big-box* appears, however, preference scales income down:

*IM*= *D* \* (*N / G*) \* *c*

The equation for the expected income of the *big-boxes* is simpler. Since they sell all goods, its number of goods is sold is not a factor in its income, and the chance a customer will shop with them is the chance they won’t shop at *mom-and-pops*, namely (1-*c*).

*IB*= *D* \* *N \** (1-*c*)

Therefore, by substitution, (c) becomes

(c’) *D* \* *N \** (1 - *c*) *~ I ~ D* \* (*N / G*) \* *c*

And this expression we may massage[[4]](#footnote-4) (dividing out common terms) into something easy to comprehend:

(1 - *c*) *~ I / (N \* D) ~* (1 */ G*) \* *c*

We may call the expression in the middle *“P”* meaning “profit threshold.”

(d) (1 - *c*) *~ P ~* (1 */ G*) \* *c*

Let both ( 1 - *c* ) and (1 */ G*) \* *c* be less than *P.* Then *big-boxes* and *mom-and-pops* are in either situation (a) or (b). We may now make an interesting conclusion about our model:

( i ) If ( 1 - *c* ) > ( 1 / *G* ) \* *c*, *big-boxes* have higher income than *mom-and-pops* regardless of population size, and income per visitor. This corresponds to situation (a).

When *c* > 0.5, as our model assumes, then consumers have at least a slight preference for *mom-and-pops*, and the only factor giving *big-boxe*s relative success over *mom-and-pops* is the number of goods sold. For instance, a good mom-and-pop-friendly town might have shop at *mom-and-pops* 75% of the time. However if there are as few as four different types of good, our inequality

(1 - *c*) > ( 1 / *G* ) \* *c*

becomes

0.25 > 0.1875

which is bad news for the mom-and-pop store because there is plenty of space for *P* to fit between those two numbers: say, *E* = $4, *N* = 20, *M* = $1. With these constants, the *mom-and-pops* would have survived without the *big-boxes*, but the *big-boxes* puts too much pressure on the *mom-and-pops*, and the *mom-and-pops* will eventually be run out of business.

We also may conclude that even in extreme cases, where there is a high preference for *mom-and-pops*, *B*s will win the day if too many kinds of goods exist in the economy. Let’s have *c* = 0.99, and *G* = 100. Then the *big-boxes* still have the upper hand:

0.01 > 0.0099

And there is still an interval where *P* can come in and ruin the *mom-and-pops* chance, leaving the *big-boxes* as the only surviving retailers.

What of case (b), where *E* *≥ IM > IB* ? We want to know under what conditions the *mom-and-pops* will run out of funds quicker than the *big-boxes*. Formally, let CX be the capital of X, then our result occurs if and only if the zero of

C*B* + t(I*B* - E) = 0 t = -C*B*/(I*B* - E)

is less than

C*M* +t(I*M* - E) = 0 t = -C*M*/(I*M* - E)

Expressed without t:

-C*B*/(I*B* - E) < -C*M*/(I*M* - E).

Massaging it a bit:

C*B*/C*M* > (I*B* - E)/(I*M* - E) = O*B* / O*M*

which basically means our condition is met whenever the relative capital of *big-boxes* to *mom-and-pops* is greater than their relative operating costs. Examples are easy to fabricate:

CB = 5

CM = 1

OB = 4

OM = 1

That is when the capital of the *big-box* is five times that of the *mom-and-pops* and its operating cost is 4 times that of the *mom-and-pops*, it will survive the *mom-and-pops*.

1. The variables pM and rM(0,1] are between 0 and 1 inclusive. pM is consumer preference for mom-and-pops, and rX is a random number. We abbreviate “mom-and-pop” by *M* and “big-box” by *B.* The subscript indicates the variable belongs to the type of retailer. [↑](#footnote-ref-1)
2. There are 26 consumers, 5 mom-and-pop stores, each of which have an initial endowment of $30, gain $2 per purchase, and loose $10 per step. The big-box appears on period 20. It has an initial endowment 1000 times that of the big-box-store, and it pays five times the rent. [↑](#footnote-ref-2)
3. More specifically c = (0.5) \* pM + 0.5 [↑](#footnote-ref-3)
4. Since all terms are positive, we need not worry about the inequalities’ reversing. [↑](#footnote-ref-4)