# Can It Be Economically Rational to Restrict Big Box Retailers?

## Introduction

Conventional wisdom from committed "free market" economists would have it that moves to ban "big box" retailers such as Walmart from certain localities are rebellions against consumer sovereignty and must hurt consumer welfare. After all, if consumers did not want to shop at the big box retailer, they would simply not do so, correct? The fact that they switch their shopping to the big box and away from "mom-and-pop" stores shows they prefer the big box.

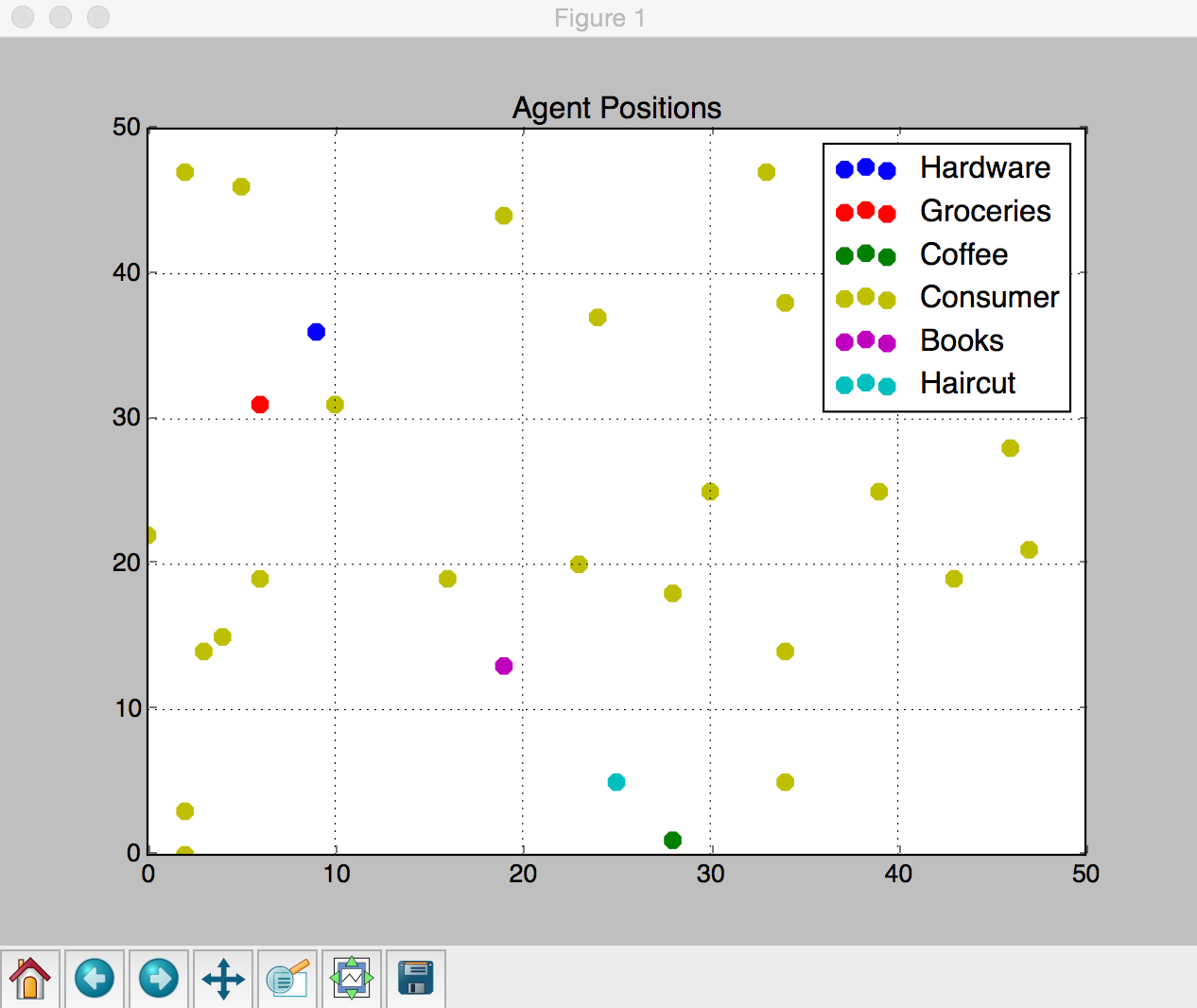
This paper attempts to show that the above analysis is simplistic. We present a model in which all consumers have the following preference ordering in some retail sector:

1. Have both local shops and a big box store.
2. Have only local shops.
3. Have only a big box store.

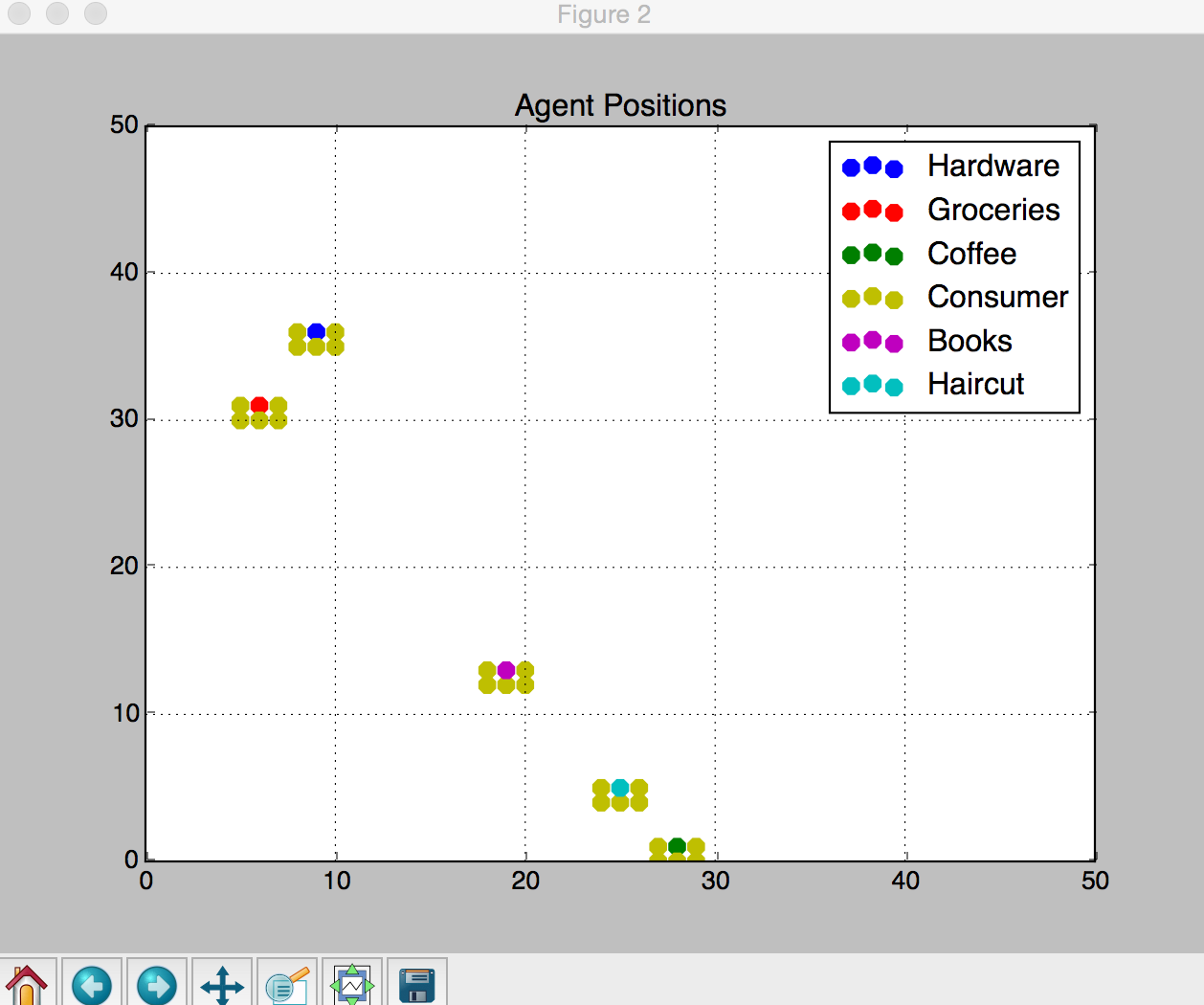
(We can further assume they know the costs of achieving 1, 2, or 3: they want 1 even if they sometimes pay higher prices to achieve it compared to 3, i.e., we could add a monthly shopping bill to each of the above.) We then show that, under not outrageous assumptions, it is easy for consumers, in trying to achieve their first preference, to instead wind up with their third.

## Design and Definition

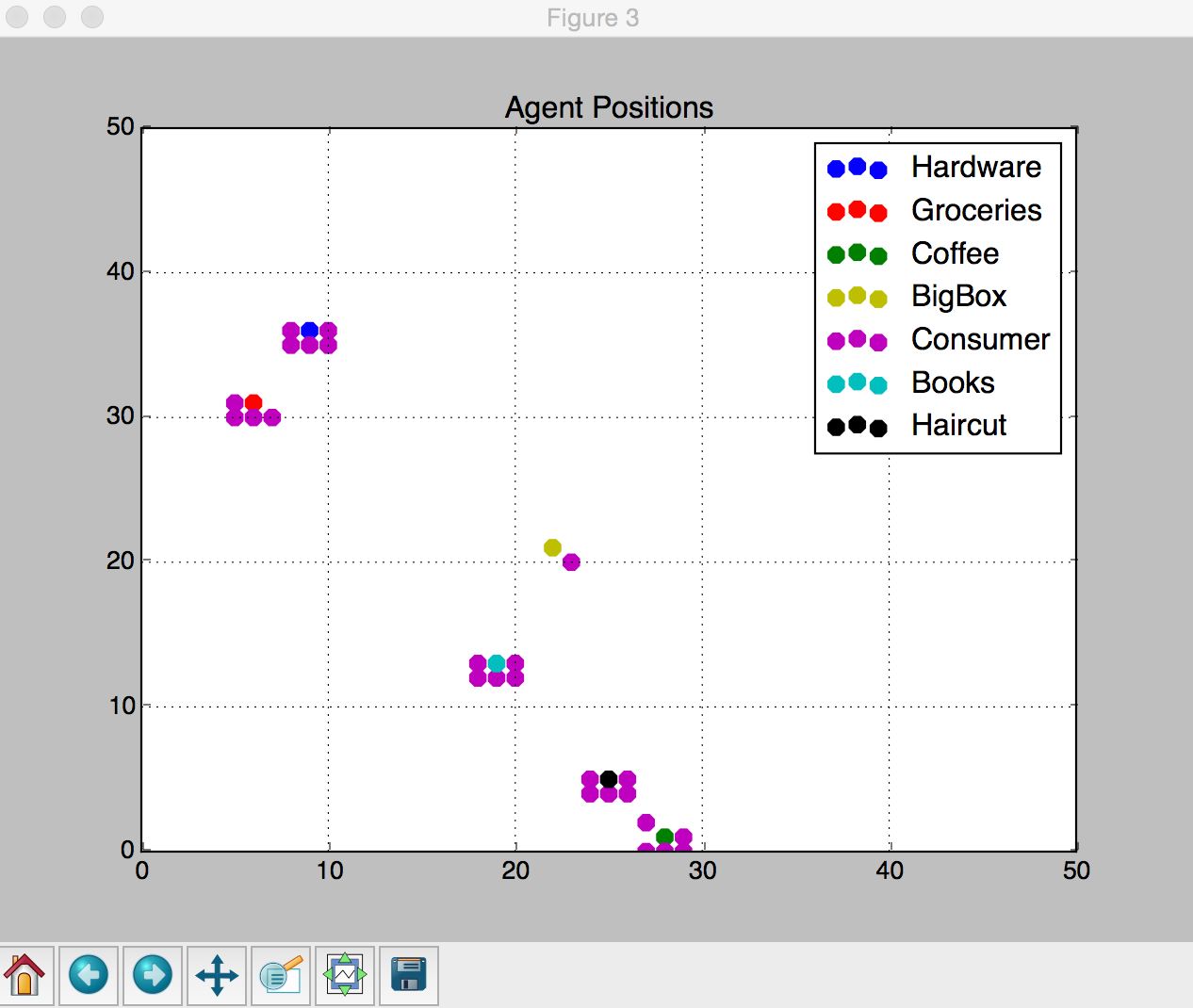
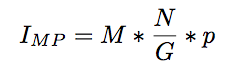
In our model we have both the big box and the mom-and-pop stores, which (for ease of reading) we abbreviate as BBs and MPs.

Initially, there are only MPs, no BBs. And our city “EverytownUSA” begins with as many MPs as there are kinds of goods to sell. So if there are G different kinds of good, there will be G different stores.

**Initial Situation**

Our city’s consumer population size is M. In each step of the model, every consumer purchases a good at one and only one store. His choice of what good to shop for is deterministic. He cycles through each of the G goods successively. This leaves MPs average income to be described as follows:

And the MPs' financial security is sustained as long as its income is greater than its upkeep expense, R:

Now when we introduce BBs into EverytownUSA, a new dynamic appears: consumer preference for MP and BB. Here the preference p is the probability customers will shop at the MP. And so, our above income equation becomes

**Consumers shopping at the MPs**

On the other hand, the consumer preference for the BB is (1-p), and so the BBs’ average income is

For simplicity’s sake, we keep the cost of upkeep for the BB the same as that of the MP, that is, R.

**The Big Box Appears**

## Formal Statement of the Problem

Now we can formally state our model.

1. Consumers want to shop at both MPs and BBs. [Formally: 0 < p < 1 and 0 < (1-p) < 1]
2. Consumers would rather shop only at BBs than MPs. [That is: p > 0.5]

But nevertheless it can occur that MPs cannot compete, or even survive, with the BBs. That is, on average:

leaving the consumers ultimately and exclusively shopping at the BB.

## The Program

Here we will dive into the specifics of the implementation of our model. What was described above in

Our model is based on Indra, and an agent based modeling (ABM) system built in Python. Since our model runs on it, it would be valuable to review its architecture. Indra includes the following capabilities:

* Looping over agents randomly, in order, in reverse order, or by type.
* Automatic generation of line graphs and scatter plots.
* The ability to enter model parameters interactively, from the command line, or from a file.
* The ability to save parameters sets.
* The ability to dump the state of the system to a JSON file.
* A built-in, extensible interactive menu.
* Automatic creation of network graphs showing the relationship among objects in the system.
* Extensible Markov-matrix capabilities for easily specified, probabilistic behavior on the part of agents.
* A flexible spacial environment model that allows the composition of agent views of the environment of any desired shape, easing the creation of models exploring limited, local agent knowledge.
* In-line debugging capabilities, allowing, e.g., the screen display of all of an agent's attributes at any point during the run of a model.
* The ability to step through a model to watch it develop in real time.

Let us look, first, at the behavior of consumers, and then, briefly, at the simpler behavior of retailers.

When a consumer acts, he surveys the world around him, evaluates his world on the basis of this survey, and he responds according to his evaluation. Naturally, therefore, we call these methods survey\_env, eval\_env, and respond\_to\_cond.

def act(self):

env\_vars = self.survey\_env()

eval\_vars = self.eval\_env(env\_vars)

if eval\_vars:

self.respond\_to\_cond(eval\_vars)

The way the consumer surveys his environment goes like this: he finds all the stores he can view (a view which happens to be the whole environment this model) and he only remembers the stores which sell the good he wants.

def survey\_env(self):

view = self.env.get\_square\_view(

center=self.pos,

distance=math.sqrt(

self.env.width\*\*2 +

self.env.height\*\*2))

n\_census = []

n\_census.extend(self.neighbor\_iter(view=view,

filt\_func=lambda x:

x.sells(self.goal)))

return n\_census

Here is how a Consumer decides where to go shopping:

def eval\_env(self, n\_census):

self.state\_pre = self.env.get\_pre(self, n\_census)

self.state\_vec = markov.probvec\_to\_state(

self.state\_pre.matrix)

self.state = markov.get\_state(self.state\_vec)

if(self.state == 0):

self.preference = MomAndPop

if(self.state == 1):

self.preference = BigBox

for store in n\_census:

if type(store) is self.preference:

return store

Consumers obtain their prehension from the Environment. We build a 2x1 matrix. The (1,1) entry represents the agent's chance of going to a mom\_and\_pop, and the (1,2) entry is that of the big\_box. If a type is not in the agents neighborhood, we cannot go there. Since this means there may be a zero entry, we must normalize the vector. For the column must sum to 1, according to the idea of a transition matrix.

def get\_pre(self, agent, n\_census):

trans\_str = ""

if(self.there\_is(n\_census, MomAndPop)):

trans\_str += "0.7 "

else:

trans\_str += "0.0 "

if(self.there\_is(n\_census, BigBox)):

trans\_str += "0.3"

else:

trans\_str += "0.0"

state\_pre = markov.from\_matrix(np.matrix(trans\_str))

state\_pre.matrix = vs.normalize(state\_pre.matrix)

return state\_pre

After choosing where to go, he goes there and buys his long sought after good.

def respond\_to\_cond(self, store):

self.move(store)

store.buy\_from(self.allowance)

After this action, the consumer now decides his goal is to aquire a new good. This goal is to be acted out during the next cycle of interactions.

def postact(self):

"""

We cycle through the goods the agent might want

turn-by-turn.

"""

self.goal = (self.goal + 1) % NUM\_GOODS

The retailer's action is much simpler. It merely pays its bills. If its funds go below zero, it goes bankrupt, and it disappears from the environment never to reappear.

def act(self):

self.pay\_bills(self.rent)

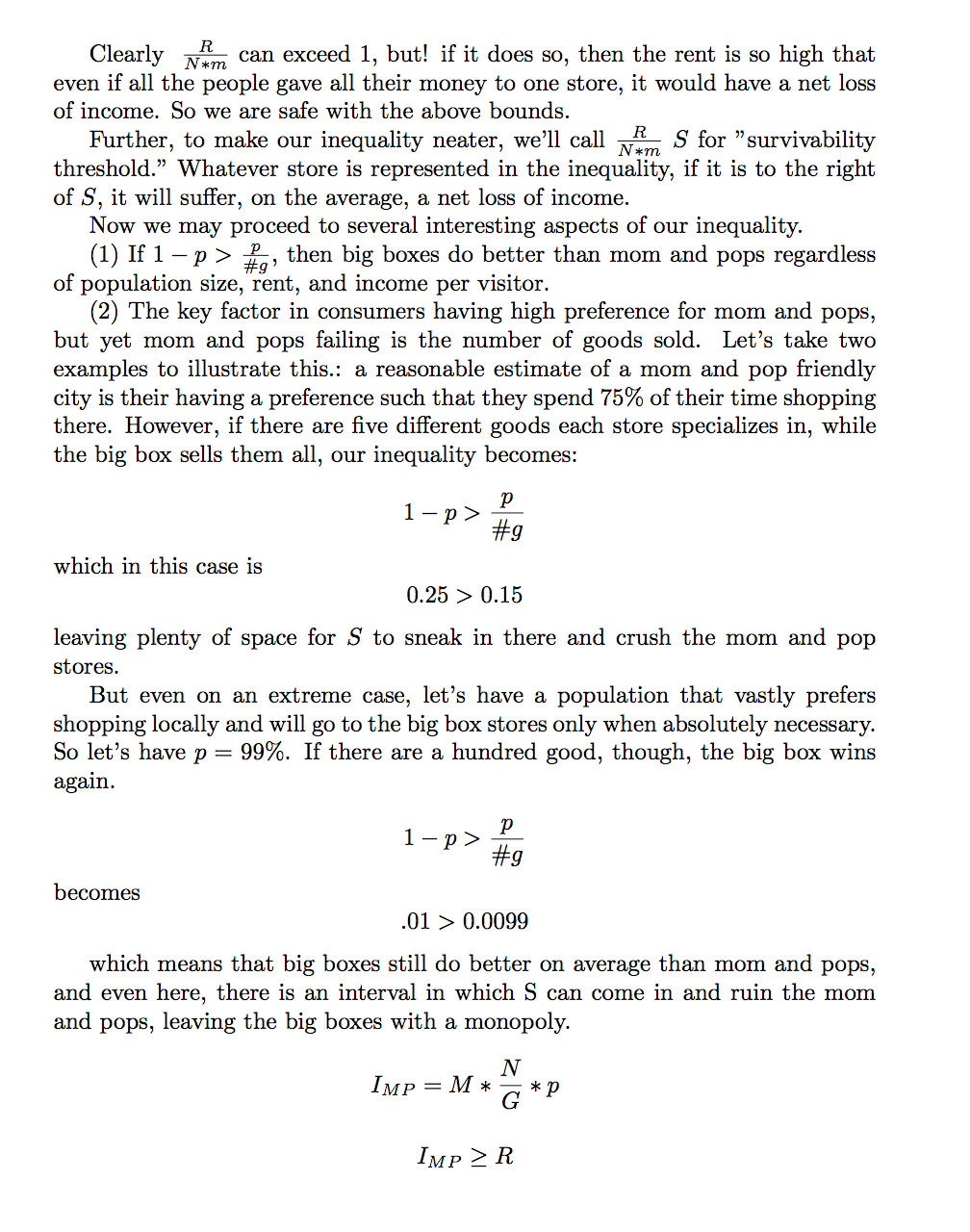
if(self.funds <= 0):

self.declare\_bankruptcy()

## Mathematical Analysis of the Model

## Conclusion

This behavior is due to consumers facing a collective action problem, as well as a knowledge problem: Consumers might, if they had perfect knowledge of the exit points of the local shops and the ability to finely coordinate their own shopping with that of others, be able to achieve their first preference (a mix of big box and mom-and-pop shopping available). But, in general, consumers have little knowledge of what percentage reduction in sales will cause a small shop to exit the industry, nor do they have very much ability to coordinate their shopping with other consumers. (The latter means that even if consumers forego a certain amount of shopping at the big box stores, which they would otherwise do, simply to keep the small stores solvent, they cannot ensure their neighbors will do the same. So their rational choice is to "defect" and shop at the big box store as often as they wish, regardless of the impact on the small shops.)

Therefore, since they cannot fine tune their shopping to achieve 1), they shop at the big box store whenever it suits them for a particular purchase, without regards to the "macro" effects of their choices. (See Schelling, 2006, for extensive analysis of the potential gap between micromotives and macrobeahvior.) They shift "too" much of their shopping to the big box, with the end result is that all of the mom-and-pops are driven out of business, despite no consumer wanting that result. Thus, it *might* make sense, faced with such knowledge and game theoretic difficulties, for consumers to bind themselves in advance to 2), by banning a, or some, or all, big box stores, or to trying to achieve 1) by, say, forcing big box retailers to locate well outside the center of town, making trips to them less convenient. (All legislation has unintended consequences, which is why we make the weak claim that these types of actions *might* make sense: such legislation might also, for instance, serve the interest of an inefficient local monopolist seeking to protect its privileged position in a market.)

## Bibliography

* Callahan, Gene and Steven Horwitz. "The Role of Ideal Types in Austrian Business Cycle Theory." In What Is so Austrian about Austrian Economics?, 14:205-24. Advances in Austrian Economics 14. Emerald Group Publishing Limited, 2010. http://www.emeraldinsight.com/doi/abs/10.1108/S1529-2134%282010%290000014013.
* DiLoernzo, Thomas. "The Myth of Predatory Pricing." Cato.org, 1992. https://www.cato.org/pubs/pas/pa-169.html.
* DiLoernzo, Thomas. "The Myth of Predatory Pricing." Cato.org, 1992. https://www.cato.org/pubs/pas/pa-169.html.
* Elster, Jon. Ulysses Unbound: Studies in Rationality, Precommitment, and Constraints. Cambridge: Cambridge University Press, 2000.
* Fernando Pérez, Brian E. Granger, IPython: A System for Interactive Scientific Computing, Computing in Science and Engineering, vol. 9, no. 3, pp. 21-29, May/June 2007, doi:10.1109/MCSE.2007.53. URL: http://ipython.org
* Schelling, Thomas C. Micromotives and Macrobehavior. New York: Norton, 2006.
* Slee, Tom. No One Makes You Shop At Walmart. Between the Lines, 2006.
* Main Street image by Larry D. Moore, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=609290>