Keeping Our Cool:
In Defense of Air Conditioning

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Abstract

In the last 15 years three books have been published that are critical of air conditioning (Cooper 1998; Ackermann 2002; Cox 2010). No books (or even articles) in those years have been primarily devoted to a general defense. Such a defense should make the following points. Air conditioners reduce disease and mortality, especially among the ill and aged. They reduce aggressive behavior, including road rage, assaults, and murders. They increase the quality and quantity of nighttime sleep. They improve student and worker productivity by reducing noise and increasing the ability to concentrate. They increase comfort and free choice.

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I. The Attack on Air Conditioning

Critics of capitalism used to claim that capitalism either never was capable of making life better for the common person, or that it would develop in a way that eventually made it incapable of making life better for the common person. Marx, for instance sometimes seemed to argue that the worker's lot was always terrible under capitalism (e.g., in *The Communist Manifesto*) but at other times seemed to give credit to capitalism for improving the lot of the worker compared to the barbarous or feudal systems that preceded capitalism (e.g., in his "British Rule in India" report[1]).

But at least since the collapse of the communism around the world, it is clear to anyone with open eyes that capitalism produces the goods, and can improve living standards for all parts of society.[2] As a result, some of the critics became less critical. But other critics simply looked for new grounds for criticism. One major ground has been the environmental case: capitalism may produce the goods, but only at too high a price in terms of damage to the environment.[3] Another ground has been to criticize the goods that capitalism produces. This ground argues, not that capitalism fails to produce the goods, but that when better examined, the goods are not really good.

And so we see a stream of books and articles claiming that plentiful food is bad,[4]

[1] For example (Marx 2003 [1853], p. 118): "I do not allude to European despotism, planted upon Asiatic despotism, by the British East India Company, forming a more monstrous combination than any of the divine monsters startling us in the temple of Salsette."
[2] Versions of this view have been widely expressed, e.g., in: Fukuyama 1992; Thomas Friedman 2000; and Yergin and Stanislaw 1998.
[3] For a discussion of environmentalism as an attack of capitalism, see: Klaus 2008.
[4] Hager 2008 has described how the Haber-Bosch technology allowed fertilizing nitrogen to be created out of the air, thereby saving millions from starvation.

and cars are bad,[5] and television is bad,[6] and computers are bad,[7] and air conditioning is bad. My belief is that these claims are generally unsound, and that if they go unanswered, a system that has been enormously successful will be undermined, leading to shorter, and less happy and less free lives.

The intellectual critics of capitalism's triumphs have often been more numerous and more vocal than the defenders, nowhere more so than in the case of air conditioning. In the last 15 years at least three books have been published that are mainly critical of air conditioning (Cooper 1998; Ackermann 2002; Cox 2010). After some sustained search, I have found no books whose main purpose is to describe the benefits of air conditioning.[8] I have not even uncovered any substantial article-length general summary of the benefits of air conditioning.[9]

What does exist, and what will be made use of here, are articles that document specific harms from heat, and specific benefits from air conditioning. In making the case for air conditioning, I will mainly focus on the benefits of air conditioning. I will mainly leave to others, or to another time and place, the discussion of the alleged costs of air conditioning. For now a few words on costs will have to suffice.

The main costs of air conditioning are usually claimed to be the environmental damage that is alleged from the increase in global warming due to the increased energy

[5] For articulate defenses of the automobile, see: Lomasky 1997, Tierney 2004, and Wilson 1997.
[6] Johnson 2006 argues for cognitive benefits from television and video games.
[7] Part of Gates 1995 is devoted to describing and predicting how personal computers make life better. Shirky 2010 describes and predicts some benefits from innovative collaboration made possible by the internet. McGonigal 2011 praises the benefits of video games, especially those that are cooperative.
[8] Schultz (2012b) discusses some of the benefits of air conditioning, but his book is mainly intended to be "a coffee-table history of the company" (Schultz 2012a).
[9] A partial exception is Robert Friedman 1984. Heppenheimer 2005 recounts the history of the development and adoption of the air conditioner, but is not primarily concerned with the benefits and costs. By "substantial" I mean something more than a brief personal commentary.

consumption that results from running the air conditioners. I believe a strong case can, and has, been made that these concerns are substantially overblown for several reasons. First, some phenomena often attributed to global warming may be due to periodic and hard-to-predict natural variations.[10] Second, global warming creates opportunities[11] in addition to problems, e.g., it would reduce the costs of shipping over,[12] communicating in,[13] and retrieving oil and minerals from the arctic,[14] and would increase agriculture and animal husbandry in places like Britain[15] and Greenland.[16] Third, other problems exceed in severity any problems caused by global warming.[17] Fourth and finally, in a system of entrepreneurial capitalism, creative inventors will find ways to reduce global warming,[18] and innovative entrepreneurs[19] will find ways to adapt to it[20] or make use of it.[21]

[10] See, e.g., Bhanoo 2009; and Hansen 2009.
[11] E.g., see distinguished scientist and futurist Freeman Dyson's case that the benefits from global warming may exceed the costs: Dawidoff 2009.
[12] E.g.: Kramer and Revkin 2009.
[13] E.g.: Joling 2010.
[14] E.g.: Kramer and Krauss 2011; Revkin 2008; Mouawad 2008; and Krauss 2005.
[15] E.g.: Naik 2010.
[16] E.g.: Faris 2008; and Etter 2006.
[17] E.g.: Lomborg December 15, 2009; Lomborg, November 9, 2009; Lomborg, November 2, 2009; and Lomborg, October 23, 2009.
[18] E.g.: "Bacteria and Climate Change; . . . " 2010; Stephens 2009; Hotz 2007.
[19] One of the advantages of flexible economic systems, such as capitalism, is that they can adapt to unexpected or exogenous changes in the environment (e.g., changes in the weather). In the empirical analysis quoted from below, the primary finding is that roughly half of the short-term negative effects on income from rising temperatures, "are offset in the long run through adaptation." Almost all of the countries in the sample of 12 deviate substantially from the ideal of entrepreneurial capitalism. So the reduction by half is probably a much smaller amount of adaptation than would occur in a sample of countries that had adopted policies that allowed a flourishing of entrepreneurship. "Using subnational data from 12 countries in the Americas, we show that the negative crosssectional relationship between temperature and income exists within countries, as well as across countries. We then provide a theoretical framework for reconciling the substantial, negative association between temperature and income in cross section with the even stronger short-run effects of temperature shown in panel models. The theoretical framework suggests that half of the negative short-term effects of temperature are offset in the long run through adaptation." (Dell, Jones, and Olken 2009, p. 203)
[20] E.g., Ouroussoff 2010; Sengupta 2009. On the adaptability of Paleolithic humans major climate change, see: Rothstein 2010.
[21] E.g.: Revkin 2009.

II. What Is Beneficial?

People differ on their view of the most comfortable temperature. But air conditioning need not impose a particular temperature on everyone. Air conditioning opens the possibility that each of us has control of the temperature that we experience. In enlightened office buildings, workers have the freedom to choose the temperature in the space that they occupy. And in their own homes, owners have the freedom to choose the setting of their thermostats. Whatever their view of the good life, whatever their concept of happiness, scholars as diverse as Milton Friedman (e.g., Friedman and Friedman 1980) and global survey researcher Ronald Inglehart (e.g., Inglehart and Welzel 2005) agree that a substantial majority of people want to be free to choose.[22]

So one criterion for judging the benefits of a good like air conditioning is the extent to which it increases people's sense of choice and control over their lives. Beyond that, evaluating the benefits of a good requires knowing what life plans it enhances or hinders. So a secondary criterion would be the extent to which the product enhances a wide set of plausible, actually chosen life plans. A likely candidate for such a good would be one of those that Rawls (1971) described as "basic goods," those that are needed to achieve almost any life plan, e.g., health, longevity, food, clothing, and shelter.[23] Air conditioning is similarly a basic good for many popular and defensible life

[22] E.g.: "As we demonstrated in Chapter 6, opportunities for making autonomous choices are closely linked with human happiness. This association holds true in a systematic way that operates across cultures: in all cultural zones, societies that offer their people more room for choice produce higher levels of overall life satisfaction and happiness. A society's level of subjective well being is a strong indicator of the human condition, and it is systematically linked with freedom of choice." (Inglehart and Welzel 2005, p. 288)

[23] Some may recoil at the use of Rawls as part of a case for capitalism, since his own position was not solidly supportive of capitalism. But Rawls fundamental analytic tools may be sound or useful, even if his own extended application of them is not. Recall that in his Preface to the second volume of *Law, Legislation and Liberty*, F.A. Hayek wrote (p. xiii) of Rawls' *A Theory of Justice* that: ". . . the differences between us seemed more verbal than substantial" and ". . . we agree on what is the essential point."

plans (though perhaps for not so broad a group as health, longevity and the like). Air conditioning will be useful whether your view of the good life is to write the great American novel, watch a good movie, or invent a better battery.

The household production approach originated by Gary Becker,[24] and most notably developed in Michael and Becker (1973) is in some ways a similar approach to that of Rawls. In Becker's view the household combines market goods with time in order to produce the "commodities" that yield utility. (Biddle (2008, p. 420) has explicitly argued for treating air conditioning as a market good that enters the household production function.) The market goods in this approach are instrumental in producing the higher order goods (a.k.a. "commodities"), similar to how Rawls' basic goods are instrumental to achieving various conceptions of the good life.

In both the Rawls and Becker approaches there is a simple hierarchy in which basic goods are the foundation for achieving higher order goods. We could go further and plausibly, but more controversially, endorse more complex hierarchies of values like that endorsed by the great Austrian economist Carl Menger (1981), or more famously, by the psychologist Abraham Maslow (1954).[25] In this view, economic systems that best allow us to move up the hierarchy of values, are candidates for the best systems.

For our purposes it is not necessary to decide which of these views is closest to being correct. If we can show that a good is one of Rawls' basic goods, or one of

[24] Examples of Becker's approach can be found in Michael and Becker 1973 and Stigler and Becker 1977.
[25] Schumpeter 1950, p. 131 mentioned "the fact that as higher standards of life are attained, these wants automatically expand and new wants emerge or are created, . . . " He footnotes this passage with the comment that "Wilhelm Wundt called this the Heterogony of Aims . . ." (Wundt is viewed as one of the founders of psychology.) A rich array of economists have adopted what has been called an hierarchical value theory, the best known version of which is that now associated with the psychologist Maslow. Perhaps the most notable economist to propound such a theory was Carl Menger, the founder of the Austrian School of economics, and the teacher of Schumpeter's teachers in Vienna. (On the history of hierarchical value theory in economics, see: Drakopoulos and Karayiannis 2004.)

Becker's market goods, or one of the goods at the base of a Mengerian or Maslovian hierarchy, then we will have made a strong and robust case that the good produces benefits.[26]

III. The History of Air Conditioning

Control of body temperature in the face of wide variations in climate, has been key to the comfort, and even the survival of humanity, going back many thousands of years. Anthropologist Brian Fagin has gone so far as to speculate (p. 13) that the key technology that led to the survival of our Cro-Magnon ancestors and whose absence led to the extinction of Neanderthal humans, was the eyed needle, which allowed the sewing together of animal skins in layered ways that provided Cro-Magnons greater warmth in cold climates.

Robert Gordon (2000) suggests that we look at the images collected by Otto Bettmann (1974) in order to fully understand and appreciate the beneficial effects of the inventions that came with the industrial revolution.[27] In the section on "Summer" in the chapter on "Air" Bettmann calls air conditioning a "blessing" and includes an artist's

[26] By focusing on the contribution of air conditioning to free choice and to the basic goods, we will perforce neglect some costs and benefits that have been alleged for air conditioning. For example, a producer of country music in Nashville was once quoted as claiming: "air conditioning is going to ruin country music. A country boy has got to sweat or he ain't nothing" (Fox 1979). It would take too much time both to establish the truth of the producer's causal claim, and then, if true, to further establish whether the result should be counted as a cost or a benefit.

[27] To introduce his own discussion of the benefits of the industrial revolution in his *Journal of Economic Perspectives* article, Robert Gordon writes: "To understand the profound sense in which the great inventions of the Second Industrial Revolution altered the standard of living of the average American resident, we begin with a brief tour of some of the less desirable aspects of living in the late nineteenth century. An eye-opening introduction to the conditions of that era is provided in a little-known book by Otto Bettmann (1974), the founder of the famed Bettmann photographic archive, and I paraphrase and quote from that book in the next four paragraphs" (Gordon 2000, p. 58; in the quote I have corrected Gordon's misspelling of Bettmann's last name).

sketch with the following caption: "New York's slum dwellers escape from their windowless hovels. "On a hot night the streets are filled with families all panting and praying for fresh air" (Bettmann 1974, p. 13).

Heppenheimer (2005) claims that the human effort to cool their living quarters is widespread and ancient. He says there is evidence that "ancient Greeks, Romans, Jews, and Chinese all collected ice and snow for cooling." He specifically mentions that a caliph from the eighth-century, Mahdi of Baghdad, forced hundreds of slaves to carry snow from the mountains to keep his summer palace cool.

Streever mentions (2009, pp. 161-164) that Cornelis Drebbel cooled Westminster Abbey in 1620 for King James I, whose girth and attire contributed to his being uncomfortably warm in the summer. Apparently it is not known exactly how he did this, although it has been speculated that he used a combination of preserved snow, and potassium nitrate that, when mixed with snow, absorbs heat.

Bryson (2010, pp. 123-124) has noted that the middle class were quicker to install gas lighting in their homes than were the rich. His explanation is that the great benefit of gas lighting in the home was to reduce the time and effort for performing a variety of services. But this was mainly a benefit to those who performed the routine and exhausting services. The rich had servants to perform these services for them; the middle class were more on their own.

For a more recent example, consider Crowell's observation (1997) that in 1948, before air conditioners were widespread, rich Washington, D.C. hostesses would entertain guests in the summer by chartering Potomac river cruise ships for the evening, an expedient presumably not available to the capitol's poor and middle class.

These episodes suggest that air conditioners might be another example of Schumpeter's claim that the glory of capitalism is that it brings within the reach of ordinary people, goods and services that was previously available only to the rich.[28]

Ford was not the first to make a car; he was the first to make a car that the middle class could afford. Edison was not the first to make a light bulb; he was the first to make a light bulb that the middle class could afford. Carrier was not the first to invent air conditioning; he was the first to make air conditioning available to the middle class (in theaters) at a price that the middle class could afford.

In the era since the industrial revolution, the desire for cool relief from the heat of summer first took the form of a bold enterprise to transport lake ice wide distances. This story of entrepreneurial triumph is briefly told by Bryson (2010, pp. 71-75) and at greater length by Weightman 2003. In an example of the leapfrog competition of creative destruction, the successful innovation of distantly transported lake ice was itself creatively destroyed by the even greater related innovations of refrigeration and air conditioning.

In the two centuries, several inventors and innovators worked on developing an effective and efficient air conditioner, including John Gorrie, Nikola Tesla[29], Willis Carrier and Thomas Midgley. Gorrie's story is a sad one. He received a patent for his version of the air conditioner, but failed to raise sufficient funds to develop it, and died a poor and broken man (Burke 1978, p. 241).

Carrier made the large-scale air conditioner, for comfort in theaters, stores,

[28] "Queen Elizabeth owned silk stockings. The capitalist achievement does not typically consist in providing more silk stockings for queens but in bringing them within the reach of factory girls in return for steadily decreasing amounts of effort." (Schumpeter 1950, p. 67)
[29] Hughes 1985. But Hughes does not elaborate on the nature of Tesla's work on air conditioning.

museums and office buildings, a practical and affordable product. Carrier found a new way to dehumidify air, which he patented and continued to perfect, to great success (Johnson 2010, p. 215). In summarizing Carrier's achievement, Steven Johnson says that "Carrier's narrative fits the classic mold of the genius entrepreneur" (Johnson 2010, p. 216). Carrier's major contribution was to increase users' control of the temperature for maximum comfort (Heppenheimer 2005).[30]

Midgley's contribution was to develop Freon, which made it possible to produce air conditioning units small enough to cool a typical home (Bernstein 2002). The pent-up demand for affordable air conditioning can be seen in the rapid rate of adoption. In the United States between 1960 and 1999, the percent of households that had air conditioning leaped from about 10% to about 70% (Moore and Simon 1999, p. 19). By The rate of adoption of air conditioning in houses is documented in the figure below.[31]

IV. Air Conditioning Extends Life

Washington, D.C. has long had the reputation of being an unhealthy swamp, both figuratively and literally. When an assassin's bullet struck President Garfield in 1881, Garfield's physician's feared that the summer heat of Washington, D.C. was impairing his recovery. At first renowned scientist Simon Newcomb was enlisted to devise a primitive air conditioner, blowing air over ice (Schwarz 2006). Eventually, he was

[30] Carrier's contributions are summarized and evaluated by Johnson (2010, pp. 214-218) who sees Carrier's story as "archtypical" in its fit with "the classic mold of the genius entrepreneur" (p. 216),

[31] Similar information on the rate of adoption of air conditioning can be found in: Moore and Simon 2000, p. 113; based on U.S. Bureau of the Census, American Housing Survey for the United States in 1997; and U.S. Bureau of the Census, Housing Then and Now," www.census.govhhes/wwwhousing/census/histcensushsg html.

moved to the Jersey shore where he succumbed in spite of their best efforts.[32]

In August 1931, Thomas Edison was ailing in New Jersey. "Since the intense summer heat oppressed him, one of the new air-conditioning machines was installed in his bedroom, . . . " (Josephson 1959). In July 1944, part of the reason that the Bretton Woods agreement occurred at Bretton Woods, rather than the more convenient Washington, D.C., was that there were concerns whether John Maynard Keynes, who was ailing from a heart condition, could survive long meetings in the summer heat of Washington, D.C. (Moggridge 1992, pp. 737-738).

As recently as 2003, nearly 15,000 deaths in France were attributed to the lack of air conditioning during a heat wave.[33] When I complained to my wife about the lack of air conditioning in the Paris subway system, a French medical worker overheard us and interjected that the French believe that air conditioning is harmful to respiratory health. This is in fact the major counter-argument to the claim that air conditioning is beneficial to health. The claim, however, is easier to assert than to prove. One study that examined the issue concluded that: "We did not find any statistically significant associations between workplace AC and any of the health outcomes" (Sahakian et al 2009; with apologies to Deirdre McCloskey). And if air conditioning were ever found to contribute to airborne pathogens, the technology could be modified to address the concern. For example, substituting copper for the aluminum in air conditioners can substantially reduce the potential for any fungus accumulation (Weaver, Michels, and Keevil 2010).

Obesity is often identified as one of the most important risk-factors for disability,

[32] A fuller account of Garfield's treatment and death can be found in Millard (2011).
[33] See: "French Heat . . ." 2003; Knox 2003; and Tagliabue 2003, p. A3. See also: "The 2003 heat wave had a major effect: the overall excess mortality rate in France between August 1 and August 20 was estimated at 14800 deaths" (Vandentorren et al, 2004, p. 1519).

diseases such as diabetes, and early mortality. Evidence suggests that higher house temperatures are positively related to higher levels of obesity (Bo et al 2011, p. 1442).

For more general conclusions on the effect of air conditioning on mortality, we can consult the important empirical study followed a cohort of 72,740 from April 1980 through December 1985. One of the main findings was:

> the death rate for persons who had central air-conditioning was 42 percent lower than the rate for persons who did not have air-conditioning, after confounding variables had been controlled for. (Rogot et al 1992)

A 2002 article surveyed many studies that relate heat to an increased risk of mortality:

> The findings suggest that persons with preexisting cardiovascular and respiratory diseases have increased risk of death associated with ambient heat exposure and that risk is higher for several population groups, including the elderly, infants, and persons of low socioeconomic status. Other specific risk factors include lack of air conditioning, . . . (Basu and Samet 2002, p. 198)[34]

The importance of air conditioning to health was dramatically highlighted in a heat wave in Dallas. Thieves stole the air conditioning of an elderly woman, who then died of the heat. A neighbor described the theft as "murder" (Miles 2011).[35]

[34] Lippmann et al (2013) found that high temperatures most increased emergency room visits for males, 45-64 year olds, and rural county residents (Lippmann et al 2013). Deschenes and Greenstone (2011, p. 152) document a substantial nonlinear increase in mortality at the very high end of the temperature distribution. Fowler et al (2011) connected recent heat-related deaths in the United States to thunderstorms knocking out power for air conditioners during high heat periods. During an extreme heat event in the U.S., of those who died in their homes from heat-related causes , 91% either lacked functioning air conditioning or had the air conditioning turned off (Fowler et al 2011, p. 434).

35 In his autobiography, Sam Wyly after recalling a summer in Dallas without air conditioning says: "Thank you Willis Haviland Carrier, for inventing air-conditioning. I owe you one" (2008, p. 42).

V. Air Conditioning Reduces Aggression and Murder

"The day is hot, the Capulets abroad," (Shakespeare, *Romeo and Juliet* as quoted in Anderson 2001, p. 33)

A wide range of studies have presented evidence that rates of aggressive behavior increase when the subjects are in hot environments.[36] Often, the studies do not much discuss the ways in which the environment could or should be cooled down. But it seems a logically incontrovertible conclusion that the greater the availability of air conditioning, the cooler the living environment, and the lower the level of aggression.

Craig Anderson, a leading researcher on the relation of heat and aggression, in a brief overview of the literature as of 2001, concluded: "a simple version of the heat hypothesis (e.g., Berkowitz 1993)---that people get cranky when uncomfortable---has proven surprisingly robust to all challenges. In short, excessive heat appears to cause increases in aggression in many settings" (Anderson 2001, p. 34).

VI. Air Conditioning Improves Productivity and Learning

As long ago as 1748, Montesquieu observed that heat reduces productivity, and

36 Among the studies showing a positive relationship between heat and some form of aggression are: Anderson and Anderson 1996; Anderson and Anderson 1998; Anderson, Anderson, Dorr, DeNeve, and Flanagan 2000; Anderson, Anderson, and Deuser 1996; Anderson, Bushman, and Groom 1997; Anderson and DeLisi 2010; Baron and Bell 1975; Baron and Bell 1976; Boyanowsky 1999; Boyanowsky 2008; Boyanowsky, Calvert-Boyanowsky, Young, and Brideau 1981; Burke, Miguel, Satyanath, Dykema, and Lobell 2009; Bushman, Wang, and Anderson 2005a; Bushman, Wang, and Anderson 2005b; Carlsmith and Anderson 1979; Kenrick and MacFarlane 1984; Reifman, Larrick, and Fein 1991; Larrick et al 2011; Vrij, van der Steen, and Koppelaar 1994; Wilkowski et al 2009.

suppresses "bold enterprise" (Montesquieu 1989 ed., p. 232; see also pp. 236, 251 and 278). We can hardly even imagine all of the ways in which air conditioning has increased productivity. For example, weaving was a difficult occupation in the early 1800s for many reasons. Open windows are a poor substitute for air conditioning, but are better than nothing. But the windows apparently had to be kept closed to keep the humidity levels high enough so that the threads would not break (Lee 1992).

Before refrigeration and air conditioning, anatomy dissections could only be done during the "dissection season" due to the quick rot and unbearable smell of corpses during the warming months of the year (Teaford 2009, p. W6).[37]

Many have pointed out that air conditioning made it easier to live in the old South and in the Southwest.[38] Huntington (1924) collected data over the years 1910-1913 for men and girls making piece rate objects of hardware in Connecticut, and men making cigars in Tampa. The four main reliable samples consisted of a total of about 1,276 workers.[39] The temperature for optimum productivity of the two Connecticut samples is about 60 degrees F, and the temperature for optimum productivity of the two Tampa samples is about 65 degrees F (Huntington 1924, pp. 124 and 126). Oi (1997, pp. 121-132) presents other examples, data and analysis that strongly suggest that air conditioning increases labor productivity, especially in the South.

[37] Teaford was commenting on Richardson 2008; see also Richardson 2008, p. 255.
[38] On air conditioning revitalizing the old South, see Arsenault 1984. On the Southwest: "liberating technology, particularly air conditioning, which was like the Oregon Trail and the railroads, opening up whole new areas for development, beginning with cities like Houston and Phoenix, . . . " (Reeves 1994). Or Yeakel approvingly quoting J. Frank Dobie: "Air conditioning ruined Texas. It made it possible for Yankees to live down here" (Yeakel 1984).
[39] The main "reliable" samples in Huntington's Figure 8 (1924, p. 124) are A, B, E and F. (C and D consist of one man each, G consists of three children typing, and I consists of 1,500 students typing. Huntington says the data on G and H are "least reliable" (1924, p. 125).)

Just as workers produce more when they are cool, students learn more when they are cool. Schoer and Shaffran (1973) found that high temperature reduced performance in a variety of tasks, with a greater reduction occurring when the tasks were more complex. More recently: "the performance of two numerical and two language-based tests was significantly improved when the temperature was reduced from 25°C to 20°C (77°F to 68°F)." (Wargocki and Wyon 2007, p. 193) Another recent study finds that optimal performance at addition and typing tasks occurs at temperatures just below the temperature at which the subject reports the most thermal comfort (Lan, Wargocki, and Lian 2011).

Besides worker and student productivity, air conditioning can also substantially improve the productivity of machines. Before air conditioning, "swollen paper, broken thread, and dry tobacco leaf reduced profits of lithographers, textile mills, and cigar makers" (Oi 1997, p. 124). Air conditioning also improved the productivity of mainframe computers (Wyly 2008, p. 36). Today one of the main business and technological challenges for Google (and other "cloud' providers) is how to cheaply and effectively cool their massive data center server farms (Levy 2011, pp. 182-184 and 188-197).

VII. Air Conditioning Improves Comfort and Free Choice

Although, as we have seen, air conditioning provides well-documented increases in labor and machine productivity, most of the air conditioners installed in the 1920s through the 1950s were to help retailers sell goods and services, rather than to help

manufacturers make the goods (Biddle 2012, pp. 1074-1077). In weighing the costs and benefits, apparently air conditioning was even more important for consumer comfort, than it was for worker productivity.

People generally seek comfort most of the time. Bill Bryson (2010, p. 135) points out that for most of its existence humanity has been consumed with simple survival, and that the use of "comfortable" in the modern sense only began with Horace Walpole in 1770. Biddle (2008, p. 420) writes that in the United States "people were enthusiastic about the idea" of air conditioning, citing a 1959 Gallup poll in which 86% of the respondents preferred an air conditioned home in preference to a home that lacked air conditioning. The importance of the comfort of air conditioning relative to other inventions is hard to measure or judge. But entrepreneur Sam Wyly (2008, p. 42) and economist Robert Gordon (2000, p. 60) have independently concluded that for anyone who has spent a summer in Texas, air conditioning is more important than the internet.

Sometimes even those who oppose air conditioning admit that it increases comfort. Robert Post quotes a "fan" of street cars who seems nostalgic for discomfort. The fan was "applauding" street cars when he remembered that they "were noisy and uncomfortable—they jolted and rocked. The seats had hard, straight backs and the only air conditioning was an open window [and] often, in the wintertime, the only warmth was from too many bodies," (Post 1998; bracket was in Post's version of the fan quote).[40]

Morley Safer describes a painting that portrays the difficulty of transporting a

[40] In Cuba, few have air conditioners. In some limited ways, a refrigerator is a substitute for an air conditioner. Many in Cuba have nursed along GE refrigerators that were made before the Communist revolution. These refrigerators are often viewed as prize possessions; and avant-garde artists put on a bold show honoring the GE refrigerator (Romero 2007, p. 3).

soldier in Vietnam to his precious R & R:

> That extraordinary technology we brought to the jungles of Southeast Asia, the well-oiled firepower, the superbly trained aircraft commander, nervously checking over his shoulder to see his cargo hadn't shifted. The door gunner on full alert, flak jacket in place, ready to fire. All to give a fella a week with his wife and air conditioning. (Safer 1991)

For those in a jungle of danger and heat and randomness, air conditioning was something to look forward to, something to fight for. Air conditioning was respite and comfort and control.

VIII. Conclusions

Schumpeter famously suggested (1950, p. 83) that the essential fact about capitalism was its dynamic process of creative destruction. For many critics, the rejection of capitalism may fundamentally be a rejection of dynamism.[41] One visitor from Europe, where air conditioning is much less common,[42] suggested that air conditioning is a symbol of the American spirit. Beppe Severgnini (according to Felton) "notes that the refusal to suffer the sweaty indignity of equatorial heat is "the antithesis of passive resignation," and thus a perfect expression of the can-do American character" (Felton 2010, p. W9).

Being an open-minded, balanced, objective scholar, I must admit that there does

[41] Postrel 1998 has suggested that the most useful political categories are not "conservative" and "liberal," but rather "stasist" and "dynamist."
[42] When we have visited Europe in the summer we have sometimes been told that it does not get warm enough there for air conditioning to be useful---we beg to differ.

appear to be one very substantial cost to air conditioning. Russell Baker pointed out[43] that before air conditioning, the stifling heat of a D.C. summer drove Congress out of town. After air conditioning, Congress has stayed in session longer, passing more laws.

[43] Baker was quoted in Oi 1997, p. 124, who had found it quoted in Arsenault 1984, p. 605. I first remember hearing the point made by Burt Folsom at a Young America's Foundation gathering on 8/1/05 that was broadcast on CSPAN-2 on 8/2/05.

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