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**Efficiency Neglect:**

**Why People are Pessimistic about the Effects of Increasing Population**

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**Abstract**

In six studies, we find evidence of efficiency neglect: when thinking about the effects of population growth, people intuitively focus on increased demand while neglecting the changes in production efficiency that occur alongside, and often in response to, increased demand. In other words, people tend to think of others solely as consumers, rather than as consumers as well as producers. Efficiency neglect leads to beliefs that the real costs of some consumer goods are rising when they are actually decreasing, and may contribute to anti-immigration sentiments because of the fear that increasing local population creates competition for fixed resources. We demonstrate that economic pessimism and anti-immigration sentiment are reduced when people are prompted to consider their own beliefs about increased productivity over time, but are unchanged when they consider their beliefs about increases in demand. Together, these findings shed light on the nature of people’s lay economic theories, while also suggesting promising interventions.

*Keywords*: Economic Pessimism, Immigration, Lay Economics

Word count: 8,812

**Significance**: This paper demonstrates the psychology behind a form of economic pessimism that has persisted for millennia and leads people to favor harmful policies.

Psychologists have long been interested in people’s lay theories and how they systematically differ from scientific understanding. For example, in the domain of physics, many people believe that a ball exiting a C-shaped tube will continue to follow a curved path, rather than a straight line (McCloskey & Kohl, 1983). In the domain of biology, people tend to believe there are specific genes that are common to all members of a species, when in fact species are defined by a distribution of similar, but not identical, genetic sequences (Hull, 1965; Keil, 2007; Mayr, 1982). Investigating the nature of people’s lay theories not only highlights differences between lay judgments and expert knowledge; it can also provide important insights regarding the attitudes and preferences that result from those theories.

Here we investigate people’s lay economic theories and in particular, a persistent lay belief which can be called “depletionism” (Desrochers, 2020). Depletionism is the belief that as populations grow, resources will not keep up with demand. As a result, individuals will become more impoverished because the things they consume will be less abundant. In other words, more people means more mouths to feed and thus, less food for all.

Forms of depletionism appear throughout written history (Desrochers, 2020; Stokstad, 2005). In *Laws*, Plato argued that a city-state’s population was ideally no larger than 5,040 households and any more growth could deplete resources to the point that some people might need to be cast off. More than two thousand years later, Malthus advocated for celibacy and reduced food consumption because he believed the demand created by exponential population growth would overwhelm food supplies. In 1968, biologist Paul Ehrlich published The Population Bomb, which argued that mass starvation was imminent because population growth was already on pace to outstrip the supply of food and resources. Several years later, Ehrlich lost a public wager with Julian Simon, an economist, betting that real costs of several natural resources would surely increase over the next decade – in fact, they decreased dramatically.

Studying the nature and pervasiveness of depletionism is important because expectations of economic patterns impact consumption, savings, and political attitudes. For example, widespread expectations of inflation can be self-fulfilling. Depletionist beliefs can also affect policy preferences. Just as Plato’s concerns about economic decline were used to support population control in the past, depletionist beliefs today are used to support protectionist and anti-immigrant policies (Desrochers, 2020; Caplan, 2001), which can give rise to destructive strains of populism. For example, in September of 2022, the right-wing populist Swedish Democrats captured over 20% of the national vote, making them the second-most powerful party in Sweden. Running on a platform that “immigration entails significant costs for Sweden,” the party argued that “queues for basically most things are long… Adding more people cannot be the solution (Sverigedemokraterna, 2022).”

**Efficiency Neglect**

The present studies help to elucidate the role of a psychological mechanism that underlies depletionism, which we refer to as *efficiency neglect*. People are correct to assume that more demand means less supply per person (as a static effect). But we argue that they often fail to consider the changes in production efficiency that arise alongside and in response to rising demand. More people means more mouths to feed, but it also means more arms to work and, importantly, more minds to create. Economic growth is driven by people discovering new ideas and the challenges of increased demand bring greater incentives for innovation, such that more people, perhaps counterintuitively, can lead to more abundance (Jones, 2022; Bricker & Ibbitson, 2019).

To illustrate, consider a layperson who thinks about how population growth since the 1980s has affected the supply of bananas. That person may readily consider a rising population–that there are nearly twice as many people on Earth today as there were in 1980–and the challenges of feeding a growing population with limited farmland. They may be less likely to spontaneously consider the innovations in agriculture and commerce that those challenges have spurred, resulting in increased per-acre yield of bananas, and transportation that is faster, cheaper, and results in less spoilage than in the 1980’s. Relatedly, when predicting how increased immigration would affect economic conditions for current citizens, people may focus on the impact of increased local population on demand for food, while neglecting to consider how increased population also strengthens the agricultural industry through more workers and more innovators. Indeed, existing research has argued that depletionist ideas are often used to promote ideas such as closed borders (Caplan, 2002).

Importantly, we do not argue that laypeople are unaware that technology has progressed over time or that it can create more abundance. Rather, we suggest that, by default, they fail to draw upon this knowledge when considering the effects of population growth on the economy. In other words, when considering the effects of population growth, people intuitively apply more of a static analysis that focuses on the limitations of satisfying an increase in demand with the same abundance of resources. They tend not to consider how an increase in demand also creates incentives to produce more efficiently and invent substitutes. Put differently, people seem to intuitively think of others solely as consumers, rather than as consumers as well as producers. We will show, however, that people *can* be prompted to consider the beneficial effects of population growth on abundance; reminding people to consider their own beliefs about technological progress does mitigate the expectation that more people means fewer goods per person.

Efficiency neglect is related to prior research finding that people often ignore dynamic and indirect effects (Baron et al., 2006; Mccaffery & Baron, 2006; Sloman & Fernbach, 2011). For instance, people often fail to account for how a future increase in their income would lead to an increase in their expenses (Berman et al., 2016). Efficiency neglect is also closely related to a belief in zero sum (Chernev, 2007; Newman et al., 2014; Johnson, Zhang, & Keil, 2022). People often perceive competition even for unlimited resources (Meegan, 2010), and zero-sum interpretations have been argued to be more intuitive than positive-sum interpretations (Baron et al., 2006; Rubin, 2003; Leiser & Shemesh, 2018; Bhattacharjee, Baron, & Dana, 2017). Consequently, people may perceive population growth as intensifying a competition over a limited supply of resources, rather than as more working hands and minds helping to increase the supply of resources.

**The Consequences of Efficiency Neglect**

In the present studies, we elucidate the nature of efficiency neglect via its downstream consequences*.* First, we show that efficiency neglect leads to a systematic misperception of how the real costs of goods have changed over time. It is important to distinguish between real costs versus nominal prices. Of course, the nominal price of most things tends to rise over time. That phenomenon reflects inflation, which monetary policy typically seeks to create in small amounts. But nominal wages also rise over time, such that it is hard to get a sense of whether things are getting more or less expensive in real terms without taking into account changes in wages. One way to get a sense of how the real costs of goods have changed is to calculate how long people have to work to purchase similar goods at different times. Here we calculate such a metric (hours worked) by dividing nominal prices at a given time by the concurrent average hourly wage (see Cox & Alm, 1999).

Using such a metric, one sees that the real costs of many goods have decreased substantially over time. In 1980, it would have taken the average American worker[[2]](#footnote-2) approximately 80 hours of work to afford a Sears Kenmore refrigerator-freezer unit. Today, a similarly-sized unit requires about 20 hours of work. Moreover, today’s model uses about a third as much electricity, and that electricity itself can be purchased with nearly 30% less hours of work. Indeed, over the past several decades, technological advances have made production of many goods - groceries, appliances, tools, and energy - more efficient, thus increasing purchasing power for those goods. Figure 1 depicts a similar analysis of changes for various food and energy goods. A discrepancy between the trends depicted in Figure 1 and lay economic beliefs about these trends provides an opportunity to study efficiency neglect, because gains in production efficiency are the reason why these goods produced from seemingly limited resources (e.g, farmland or livestock) have gotten cheaper over time, despite dramatic population growth.



Figure 1: Changes in the real costs of consumer goods in the U.S. since 1980. Data are compiled from the U.S. Board of Labor Statistics and calculated by dividing the national average retail price by the average hourly wage of private nonsupervisory and production workers. Through June 2023, results are qualitatively similar despite a recent surge in inflation. In fact, the only three items in the figure that were more expensive than 1980 (lettuce, bacon, and oranges) have now fallen in real terms to be equal to 1980, while bananas, rice, and coffee continue to require less than half as much work as they did in 1980.

We do not make the broad claim that *everything* is getting less expensive, or that the general cost of living has fallen. Whether innovation lowers real costs depends in part on the market structure for the good in question (e.g., if there is a monopoly over the good). Moreover, we stress that productivity cannot be expected to lower the costs of human services. In the case of something like childcare, one person's “cost” is another person’s “wage,” so that the very factors that we describe as increasing the buying power of average workers will make hiring people more expensive. This duality is exemplified in Agatha Christie’s autobiography, which discusses how 100 years ago, middle class Londoners could afford to have a live-in maid and nurse, but not dream of affording a car (Christie, 1977). “Cost disease” describes the economic phenomenon where rising productivity in other areas raises salaries even in areas where productivity is not as relevant, such as orchestra musicians (see Baumol, 2012). For this reason, our studies will focus on whether people are calibrated about cost trends for goods such as groceries, consumer durables, and energy that are impacted by production efficiency, because these will be the ideal test ground for examining efficiency neglect.

Interestingly, Americans have largely remained pessimistic about their living standards as these trends have occurred. For example, nearly every year since Gallup started asking Americans what they thought about the direction of “economic conditions in the country as a whole”, most responded that they are “getting worse” (Gallup, 2023). Pew surveys found that most Americans expect the economy to weaken over the coming decades (Pew Research Center, 2019) and that only a third expect their children to be “better off than people are today” (Pew Research Center, 2006). In short, many Americans seem to believe that the real cost of living is continually on the rise and are pessimistic about the present and future economy. Global surveys find similar patterns of pessimism in developed nations across the world (Pew Research Center, 2017).

We argue that efficiency neglect plays an important role in driving such economic pessimism. For example, we demonstrate that among a nationally-representative American panel, respondents indicated that all of the consumer goods which they purchase regularly have gotten more expensive in real terms. In reality, nearly all have become cheaper. Such systematic misperceptions of economic trends are important because misperceptions of trends lead people to support policies that they otherwise would not (Mastroianni & Dana, 2022). If people overestimate the degree to which things have been getting more expensive, it could change their economic policy preferences.

Because this misperception is driven by a tendency to focus on some effects of population growth (increased demand) and not others (increased efficiency), we argue that it can be mitigated with attentional interventions. Specifically, prompting people to consider the ways population growth affects production efficiency should attenuate their economic pessimism. Returning to the bananas example, for example, we expect that prompting people to consider the agricultural innovation that occurred since the 1980’s should attenuate their belief that bananas have become less affordable. In contrast, prompting people to consider the increased demand for bananas as a result of population growth should have no effect.

Similarly, efficiency neglect leads to a belief that having more people will make the average person poorer, thus favoring anti-immigrant attitudes. Indeed, we show that reminding people to consider the effects of population growth on innovation and labor can engender more favorable attitudes regarding immigration. In contrast, asking people to consider how immigration increases demand does not affect immigration attitudes. Therefore, while depletionist beliefs appear to be pervasive, the present studies demonstrate that they can be mitigated by prompting people to consider what they already know.

How efficiency gains have accrued and fluctuate over time, whether they apply to all domains of consumer spending, and whether they are too unequal are questions that we do not address. Moreover, there may be other causes of economic pessimism besides efficiency neglect. Existing research has shown, for example, that people tend to evaluate monetary transactions in terms of nominal rather than real value, an error sometimes referred to as the “money illusion” (Mees & Franses, 2014; Shafir et al., 1997), and thus conflate inflation with cost of living (Bryan, 2002). We discuss these additional factors further in the General Discussion.

**Lay Economics**

The current research adds to a growing literature on lay beliefs about economic phenomena. Boyer & Peterson (2018) suggest that our models of the economy are a product of the past in which we evolved (see also Rubin, 2014). Whereas modern market economies rely heavily on specialization, trade, and impersonal transactions, our ancestral past relied more on collective work such as hunting and gathering in small, closed groups in which it was key to make sure everyone pulled their weight in service of a common cause. Accordingly, our intuitions may lead us to mistrust a modern, impersonal market economy which relies on people acting largely in their own self-interest.

Continuing in the vein of zero-sum thinking, Johnson, Zhang, and Keil (2022) show that laypeople tend not to believe in mutually beneficial trade–arguably the most basic building block of economics–instead believing that the seller benefits at the expense of the buyer. Because consumers believe that companies profit at the expense of people, they may derive less meaning as a result of their purchases (Mead & Williams, 2022). Williamson & Wearing (1996) interviewed 95 subjects to understand how they thought about economics. They found that while each subject’s models were somewhat unique, they all tended to confound social, psychological, and moral issues. Importantly, subjects understood phenomena like the connection between government revenue and expenditure, but did not marshal this knowledge to answer questionnaires correctly.

Caplan (2001, 2002) analyzed a large survey of both professional economists and a panel of Americans and found systematic divergence between how laypeople and economists think about labor, trade, profits, and immigration, suggesting that biases lead people to support bad economic policies. Consistent with our view that efficiency neglect will lead to economic pessimism, the most pronounced difference was that "economists are systematically more optimistic about the past, present, and future of the economy than other people are (Caplan, 2002)." More recently, economists (Andre et al, 2022) asked professional economists and laypeople to consider the effects of hypothetical shocks such as an increase in oil prices on inflation and unemployment. Economists and laypeople differed considerably in their expectations, in part because they differ in whether they tend to focus on supply-side or demand-side effects.

Perhaps the most widely examined lay economic beliefs relate to price perceptions. Contrary to price being the point at which supply and demand curves meet, consumers tend to view prices as determined conspiratorially by sellers (Leiser & Shemesh, 2018; Rubin, 2003), as if different prices result from firms being monopolists of varying altruism (Caplan, 2002). One reason that people may overestimate the amount of monopoly power that firms hold is that they overlook the disciplining effects of competition on what products firms can offer and how profitable they can be (Bhattacharjee, Dana, and Baron, 2017). As such, consumers think that goods have a fair price that is substantially lower than their retail price (Bolton, Warlop, and Alba, 2003).

Several papers to date have identified ways in which laypeople are mistaken about various macroeconomic measures, e.g., overestimating upward mobility (Davidai & Gilovich, 2015) or inflation (Georganas, Healy, & Li, 2014; Bruine de Bruin et al., 2012). Many of these results can be characterized as miscalibrations. Efficiency neglect is somewhat different. Instead, the error results from a tendency to focus on some effects of population growth (increased demand) and not others (increased efficiency). Therefore, to some extent, the effects of efficiency neglect can be mitigated by reminding people of information that they already know, which is distinct from existing phenomena that we are aware of.

**Overview of Studies**

Across six studies, we show that efficiency neglect leads to economic pessimism and negative attitudes toward immigration. Importantly, in our studies we focus on perceptions of the amount of work required to purchase individual items. Thus, whereas surveys often ask Americans about their “general” economic beliefs and outlook, our study design allows us to identify perceptions that are independent of beliefs about inflation.

Study 1 shows that among a nationally-representative sample, Americans significantly overestimate the degree to which the real costs of consumer goods have increased. Indeed, the real costs of almost all the items in question have *fallen*, such that the majority of our sample does not merely underestimate decreases in real costs, but gets the direction of change wrong. Study 1b shows a similar pattern even when considering changes since further back in time and for more expensive items. Study 2 documents the prevalence of depletionist thinking, showing that the majority of respondents expect that population growth leads to scarcity, and cite depletionist reasoning as the root cause.

Study 3 demonstrates the role that efficiency neglect plays in these misperceptions. Prompting participants to consider how demand is increasing has no effect on beliefs about how the costs of goods have changed over time (relative to control), but asking people to consider their own beliefs about technological progress mitigates the tendency to see real costs as rising. This finding suggests that people already consider increased demand, but not increased productivity when thinking about how costs have changed. Finally, Study 4 shows that efficiency neglect also affects anti-immigration sentiment. Prompting people to consider how immigration affects efficiency reduces the belief that the economic effects of immigration are zero-sum, while again, prompting them to consider how immigration affects increased demand has no effect.

In short, our studies show the majority of our respondents default to a depletionist theory about the economy: as a direct result of population growth, they believe that they have to work for longer than they did in previous decades to purchase the same goods, and that they are in greater competition with others for a fixed supply of resources. We also show that this economic pessimism is mitigated (although not eliminated) when people are prompted to consider the ways population growth affects production efficiency but is not impacted when people are prompted to consider the ways population growth affects the demand for goods.

**Study 1**

Studies 1a and 1b were surveys designed to assess Americans’ beliefs about changes in the real costs of products with which they are familiar. To disentangle inflation from beliefs about cost of living, we asked about real costs as measured in terms of labor—i.e., the amount of time an average American worker would have to work to afford each product. We then compared people’s beliefs with actual changes in real costs.

Of course, innovation has created many products that were not available in the past (e.g., smart phones, high-powered personal computing, the internet) and has changed others so much that they are fundamentally not the same (e.g., televisions, medical care, the fuel efficiency and safety of modern cars). Asking people to track the changes in real costs of such items is not indicative of beliefs about economic change, because people simply could not pay for these things in the past. Therefore, we tried to select goods in Study 1 that are roughly comparable across time, such as a pound of rice or a kilowatt-hour of electricity for one’s home.

Method

*Transparency and openness.* Sample sizes were determined prior to data collection. We report all manipulations, all measures, and do not exclude any participant who completed a study. Study materials and data are posted on the Open Science Framework (<https://osf.io/3uj8f/?view_only=f69f67e636b647eda92cfe3aa190fea6>).

*Study 1a.* Using Prolific ([www.prolific.co](http://www.prolific.co/)), we recruited a nationally representative sample of 1,000 Americans (51% female, 49% male; mean age 46). We presented participants with a list of 20 everyday consumer products and asked them to select the 10 products for which they could most confidently estimate the price in both 2009 and 2019. This and all subsequent studies were granted exemption by the Institutional Review Board at Yale University.

The 20 products were selected according to the following criteria:

1. Historical average price data on the product was available from the U.S. Bureau of Labor Statistics (BLS). Having this data not only allowed us to compare answers to a factual benchmark, but allowed us to precisely define for participants the real cost measure described below.
2. The product was roughly comparable across time periods. A gallon of gasoline, dried spaghetti, and lettuce are basically equivalent consumer products in different time periods. A basic laptop has changed substantially even in the last decade, as has state-of-the-art healthcare.
3. The product was something frequently purchased in the U.S.

To avoid cost estimations that were confounded with inflation, for each product participants selected they were provided with the “real cost” of the product in 2009 in terms of work needed to purchase. This cost was calculated by dividing the average nominal price of the good in 2009 by the average hourly wage of a non-supervisory production worker in 2009, both of which are recorded by the BLS.[[3]](#footnote-3) Participants had to pass a quiz to ensure that they understood this before proceeding to estimate how costs have changed.

We then used two measures to assess participants’ beliefs about changes in the costs of the products they selected. The first measure was a 5-point Likert-type scale that asked, for each product, whether the average worker in the U.S. in 2019 had to work for “much less” time (coded as -2), “much more” time (coded as 2) , or ”about the same” (coded as 0) to afford that product, relative to 2009. The second measure asked participants to estimate, as best they could, the amount of work time required to buy the product today. We used an incentive compatible design, where participants were given a bonus of $0.20 for every 2019 estimation that was within ± 10% of the true value. In this study and in studies 3 and 4, we also asked participants to estimate how the cost of living, in general, changes over time. Those measures and their analysis appear in Supplementary Materials.

*Study 1b.*  We conducted a second survey with a nationally representative sample of 499 Americans (50% female, 49% male, 1% other; mean age 46), also recruited from Prolific ([www.prolific.co](http://www.prolific.co)). The design of Study 1b was nearly identical to Study 1a with the following exceptions: (1) To ensure that any misperceptions in costs weren’t due to extreme beliefs about the last decade, we asked participants about a longer time horizon, comparing costs from 1980 to 2023. (2) The products that participants in Study 1a said that they purchased regularly were all relatively low-cost (e.g., bananas, apples, eggs, etc.). To ensure that any misperceptions in costs were not restricted to low-cost products, 8 out of the 18 products in Study 1b were high-cost (dishwasher, washing machine, refrigerator, oven, storage shed, lawn mower, water heater, and disc saw). These additional products were selected according to the following criteria:

1. The product is found in many households, so that participants might have an idea what it costs.
2. Versions of the product appeared in the 1980 Sears catalog, which served as our measure of nominal price, vs. the price of the most functionally similar version that we could find currently on sears.com. Again, this allowed us to calculate an actual real cost and also define for participants how it should be calculated. Participants were given pictures from sears.com and basic product specifications.

*Results*

For all the goods used in Study 1 except for bacon and beef, real costs decreased from 2009/1980 to 2019/2023. However, a series of one-way t-tests confirmed that participants believed all products required more work to purchase in 2019/2023 than in 2009/1980 (all *p*’s < .001, see Figure 2). A similar pattern was observed for the incentivized estimations. For all of the products, participants’ estimates of the amount of labor required to afford the item in 2019/2023 were significantly greater than the provided 2009/1980 amount (all *p*’s < .05, see Figure 3).



Figure 2: Study 1b. Beliefs about the amount of labor it took to afford various goods in 2023, relative to 1980. Dots reflect individual participant responses.



Figure 3: Study 1b, cost estimations. Dots reflect participants’ estimates of the amount of labor required to afford various consumer goods in 2023. Blue lines indicate the actual costs of those goods in 2023. Orange lines indicate the actual cost of those goods in 1980. Along the X-axis, orange numbers indicate the percentage of participants who estimated the cost for that good was greater in 2023 than in 1980, and blue numbers indicate the percentage of participants who overestimated 2023 prices.

Discussion

The results of Study 1 indicated that most Americans vastly overestimate the current prices of various goods, leading them to believe that those goods have become more costly over the last decades, when in reality, nearly all became less costly. We suggest that this discrepancy between perceptions and reality results from efficiency neglect: when thinking about how prices change over time, people spontaneously consider how population growth leads to increased demand, but neglect to consider how it leads to increased supply.

**Study 2**

While Study 1 demonstrated a misperception of trends consistent with efficiency neglect, it does not directly demonstrate that people are invoking depletionist reasoning. The aim of Study 2 was to assess whether people spontaneously supply depletionist explanations when evaluating a novel context. We used a combination of Likert-type scales and free responses. Participants were told about a hypothetical thriving nation. Then, participants were asked to predict how 10 years of population growth due to increased immigration, high birth rates, and low death rates would affect the supply of goods in that nation using an open-ended response. We coded for the frequency of depletionist explanations (i.e. that more people would translate into fewer goods and resources).

Next, half of the participants were asked to reconsider their reasoning while considering that population growth also means more available workers and greater incentives toward innovation, after which they were asked to predict how the abundance of goods would change (using a Likert scale, ranging from “much more abundant” to “much less abundant.”). In a matched control condition, participants were also asked to reconsider their response and responded using the same scale but were not prompted to consider how population growth affects production efficiency.

We predicted that participants would most commonly invoke depletionist reasoning in predicting the effects of population growth on the supply of goods and that reminding people of production efficiency resulting from population growth would attenuate pessimistic beliefs about the impact of population growth on the supply of goods.

Method

*Transparency and openness.* Sample sizes were determined prior to data collection. We report all manipulations, all measures, and do not exclude any participant who completed a study. Study materials and data are posted on the Open Science Framework (<https://osf.io/3uj8f/?view_only=f69f67e636b647eda92cfe3aa190fea6>).

Using Prolific ([www.prolific.co](http://www.prolific.co/)), we recruited a sample of 200 Americans (50% female, 50% male; mean age 39). All were given the following prompt:

Imagine a fictitious country named *Gauderia.* Gauderia is a peaceful nation. The residents of Gauderia live comfortably: equality, proposertity, health, and well-being are all relatively high in Gauderia compared to other nations.

Now, suppose that the population of Gauderia dramatically increases due to a combination of factors including high birth rates, low death rates, and increased immigration. How will this population growth impact the economy?

Specifically, we’d like you to imagine 10 years in the future after the population increase. What do you think will happen to the supply of everyday goods like food, consumer products and household items? Will those things be more abundant, less abundant or about the same?

Participants were given an opportunity to write whatever they wished in a free-response text box.

On the next page, participants were given one of two prompts. In the *default belief* condition, participants read the following:

Past research has found that sometimes providing an opportunity to “think again” changes peoples’ opinions. Please take a moment to reflect on the same problem. Now, we’d like you to imagine 10 years in the future after the population increases in Gauderia.

 In the *efficiency prompt* condition, participants were specifically prompted to consider the effects of technological and production efficiency arising from an increased population. They read:

Past research has found that sometimes providing an opportunity to “think again” changes peoples’ opinions. Please take a moment to reflect on the same problem. This time, we’d like you to focus on other aspects of population growth. It’s true that more people means more consumers. But, more people also means that there are more workers, more ideas to contribute to innovation, and greater incentives to improve technology. Now, we’d like you to imagine 10 years in the future after the population increases in Gauderia.

By comparing this “heavy-handed” manipulation, which explicitly drew participants’ attention to production efficiency, to the *default belief* condition, we were able to assess the extent to which people spontaneously consider production efficiency in their reasoning about population growth.

All participants then responded to the following question: “What do you think will happen to the supply of everyday goods like food, consumer products and household items? Will those things be less abundant, more abundant or about the same?” using a 5-point scale (2=much more abundant, 1=somewhat more abundant,0=About the same, -1=somewhat less abundant, -2=much less abundant).

*Coding of Responses*. Responses were coded by a separate sample of 300 Prolific participants. Each of the coders was provided with 20 randomly selected responses (from the pool of 200). For each response, a participant indicated whether the statement contained a “depletion” argument (yes vs. no) and whether the statement contained an “efficiency” argument (yes vs. no). Coders were instructed that a response contained a depletionist argument if it talked about how having more people creates competition over goods. Example language provided to participants included "things will be harder to afford," "resources will be strained," "there will be less of everyday goods to go around," "there will be less jobs for everybody," or "demand will outweigh supply." The focus, they were told, “was on the increased number of people as consumers of the things Gauderia already has.”

Coders were instructed that a statement contained an efficiency argument if it talked about how having more people increases the production of goods. For example, the response might include language like "there will be more innovation," "there will be more people to contribute to the economy," "there will be more workers and more jobs," "over time, things will become as/more abundant," or "a higher population means more people producing." The focus in this case “was on the increased number of people as producers, or as leading to new production of things in Gauderia.”

Each response was independently coded by 30 coders, and a response was categorized as containing “depletionist” (yes vs. no) and “efficiency” (yes vs. no) arguments if at least 20 of the 30 coders categorized it as such (*p* < .05 via a binomial test). This coding scheme produced four categories of responses: depletionist, efficiency, both, and neither.

Results

Overall, 49% of participants invoked only depletionist reasoning. By comparison, 25.5% invoked only efficiency reasoning; 9% of participants invoked both kinds of argument, and 16.5% provided reasoning that could not be coded as either depletionist or efficiency. Further, when we examined how the written responses related to the judgements of abundance (described further below), of the participants who invoked efficiency explanations, only 12 predicted that things would become *more abundant* as a result of a growing population. Thus, just 6% of our sample both spontaneously talked about people producing things and thought that Gauderia would have more abundance. Examples of depletionist and efficiency reasoning are presented in Table 1 below (all responses are available at the osf):

Table 1. Examples of Depletionist and Efficiency Reasoning in Study 2a.

**Examples of Depletionist Reasoning**

10 years in the future, this country is beginning to struggle. There is only so much land and resources, so goods are starting to become more scarce. There are more people fighting over resources than ever before. A once peaceful nation has become more tense and there is a sense of danger brewing due to the economic conditions.

I think this place sounds like a nice place to go to but with the population increasing then I think it could lead to resources being scarce and fighting happening

The supplies of food, consumer products, and household items will be too low, and in high demand, driving up the prices.

The economy will become worse as people experience high inflation due to the population increase without increase in available jobs. Unemployment is high, and people are angry.

It's very simple - ten years after a large population boom, supply would decrease. It boils down to basic economic theory/principles: as demand increases, supply decreases.

The supply of everyday goods would decrease and the demand for them increase due to the drastic population increase.

I imagine that the peaceful nation of Gauderia thrives as it does because of the population control, whether natural or other. If the population of this city were to increase substantially, it would have lasting effects on the economy and other aspects of community life. More people in a country means less resources to go around.

I feel that with the continuation of the population increase, resources and supplies will become less abundant. The cost of living would increase as the supply would not be able to meet the demand of this population. It would require more imports or goods from other countries which could become very costly.

As the population increases, demand for items increases. This will increase the costs of the items. Supplies will decrease due to the increase of demand.

Less abundant/more expensive due to increased demand.

I think things will become less abundant because of the amount of individuals consuming it

**Examples of Efficiency Reasoning**

It would be good for the economy. People will work hard the talented will rise and be prosperous.

I believe 10 years would cause a temporary boom in economic prosperity, but reduce overall value of the currency. The population increase would give more work and more production, but more production of basic items, and more consumption would raise prices overall.

The influx of immigrants will increase new ideas and the increase in population pressure will present a need for those new ideas. They will come up with new solutions to bring equilibrium back to their community.

I think that the increase in the population would be a good thing. There would be people from all over coming into the country, bringing their life and traditions with them. I think there would be an increase in supplies. More consumers, more workers.

More abundant, more workers and farmers to harvest and come up with innovative ways to grow food efficiently. Though maybe there is a problem with not having enough land, I’m not sure how big this fictional place is.

I could see it having both costs and benefits, but overall I think the economy would benefit. There would be some costs in terms of people living past retirement age, more childcare, and increased consumption of food and other products. But I think they would be outweighed by the benefits of immigration, because that would introduce many working age adults into the economy, increasing production and allowing the country to keep its supply of consumer products relatively stable.

I think that it really depends. Obviously, demand for supplies will increase significantly. But with the increase in population comes the increase in economy and workers. So if things are planned right, the nation should be able to thrive.

I think that the overall economic output of the country would increase. There would be more people available to contribute to the economy, thinkers, workers and this would improve the quality and quantity of consumer goods. There may be inflation involved, but that would be expected.

The knee jerk reaction is to assume that inflation will occur as supply can't keep up with demand. But that isn't necessarily the case. Gauderia may have been planning for increasing population and may actually need more workers to fully utilize all their natural resources.

It's also possible that the immigrants could bring new skills, ideas and entrepreneurship and the country will then begin to export products resulting in an overall increase in the successfulness of the country.

After being asked to think again, participants on average thought that goods would become less abundant (*M* = -.34). As predicted, these ratings differed between the *default belief* condition (*M* = -.60) and the *efficiency prompt* condition (*M* = -.07), with participants in the default condition predicting significantly less abundance, *t*(198) = 3.84, *p* < .001. This implies that while most participants did not spontaneously consider production efficiency resulting from population growth, highlighting it increased the extent to which they thought goods would be more abundant in the future. Notably, even when given the efficiency prompt only 27% of participants rated that goods would be somewhat or much more abundant, suggesting that depletionist intuitions may be quite “sticky” and difficult to override.

*Study 2b.* We conducted a follow-up study, which used a simplified design. In Study 2b, 400 Americans (46% female, 49% male, 5% other or prefer not to answer; mean age 35) reviewed very similar materials, but the “think again” part of the protocol was omitted. In the *default belief* condition, participants read the same paragraph about Guarderia and were asked: “What do you think will happen to the supply of everyday goods like food and consumer products in Gauderia after 10 years of population growth? Will they be less abundant, more abundant, or about the same as before?” In the *efficiency prompt* condition, participants read the same information with the additional prompt at the end: “When answering, consider how population growth affects the number of Gauderian workers such as farmers and factory workers, as well as incentives for technological innovation and production efficiency.” Thus, this manipulation did not suggest that population growth would *increase* production efficiency.

The results were the same as in Study 2a. Participants on average thought that goods would become less abundant (*M* = -.23, p < .001). As predicted, these ratings differed between the default condition (*M* = -0.48) and the efficiency prompt (*M* = 0.02), with participants in the default condition predicting significantly less abundance, *p* < .001*.*

Discussion

The results of Studies 2a and 2b are striking. Unprompted, 58% of participants spontaneously mentioned some form of a competition for goods resulting from more people—i.e., more people = fewer resources. Some of these responses cited that it was “basic economic theory.” In contrast, only 26% of participants mentioned the productive aspects of more people. Moreover, only 12 participants out of 200 (6%) provided reasoning that unambiguously supported the conclusion that more people = more resources, a mainstream conclusion in macroeconomic modeling (Jones, 2022); even in cases where participants did mention that having more people increases the production of goods or the number of available workers, they did not expect those efficiencies to translate into an overall increase in resources. Taken together, these data provide strong evidence that people’s default theory favors depletionism. Providing evidence for the hypothesis that efficiency neglect drives depletionist reasoning, we also found that prompting participants to consider production efficiency somewhat attenuated pessimistic predictions about population growth, whereas merely prompting participants to reconsider their response did not.

Study S1 in the Supplemental Materials provides related evidence of depletionist reasoning as it relates to reasoning about changes in real costs. Participants’ aggregate judgments of how the real costs of several products from Study 1 would change in the future were almost perfectly correlated with their aggregate beliefs about how limited (vs. unlimited) were the inputs used to make these products. Such expectations that costs increases are purely determined by limits on resources ignore the dynamics of supply and demand, and thus, also strongly suggest that people are thinking about depletionism and not considering how efficiency might impact the supply of goods.

Studies 3 and 4 demonstrate the mechanism of efficiency neglect more directly by exposing participants to attentional prompts and showing that they apparently think about rising demand but don’t spontaneously use their own beliefs about increasing efficiency.

**Study 3**

 We propose that when people think about how the costs of goods change over time, they intuitively focus on increases in demand, while neglecting increases in production efficiency. Therefore, prompting people to consider changes in production efficiency over time should reduce perceptions of rising real costs. By contrast, asking people to consider changes in demand should have no effect, because demand is already top of mind.

In Study 3 participants were again asked to estimate how the amount of labor required to purchase various products has changed over time. However, prior to estimating the labor cost of each product, participants either made no additional evaluation (control condition), evaluated whether production of that product became more or less efficient over time, or evaluated whether demand for that product increased or decreased over time. We predicted that asking participants about changes in production efficiency would reduce the extent to which they believe products have become more costly. However, asking participants about changes in demand should not affect their judgments relative to control, since we hypothesize that demand is already top-of-mind when evaluating changes in cost.

Method

*Transparency and openness.* Sample sizes were determined prior to data collection. We report all manipulations, all measures, and do not exclude any participant who completed a study. Study materials and data are posted on the Open Science Framework (<https://osf.io/3uj8f/?view_only=f69f67e636b647eda92cfe3aa190fea6>).

We recruited 298 Americans on Amazon Mechanical Turk (39% female, 61% male; mean age 36). Participants were randomly assigned to one of three between-subjects conditions: efficiency, demand, or control. In all conditions, participants were asked to estimate how the real prices - i.e., amount of work required at the average hourly wage - of 6 products (gasoline, chicken, refrigerator, eggs, electricity, and tomatoes) had changed from 1980 to 2018, using the same 5-point scale as in Studies 1a and 1b.

Prior to providing a response for each product, participants in the efficiency focus condition were asked to evaluate whether production of that good was more or less efficient in 2018 than it was in 1980. For example, before rating how much the real price of tomatoes had changed, participants answered the question *is the average yield per acre of agricultural land today higher or lower than it was in 1980?* on a 5-point scale from *much lower* to *much higher* than 1980. Participants in the demand focus condition were asked to evaluate whether the resources required for production were more or less strained than in 1980. Continuing with the tomatoes example, participants answered the question *are there more or less acres of agricultural land per person today than there were in 1980?* on a 5-point scale from *much less* to *much more*. Participants in the control condition did not make any evaluation prior to estimating price changes. A complete list of these prompts is in the Supplemental Materials.

While answering such questions immediately before estimating prices might seem like a heavy-handed manipulation, we note two things. First, we do not tell people whether tomatoes are grown and harvested more efficiently or whether farmland is more limited; we allow participants to invoke their preexisting beliefs. Second, the manipulation is equally heavy-handed in the efficiency and demand focus conditions. Our prediction, however, is that the demand focus prompts will not meaningfully influence judgments, because participants spontaneously consider increasing demand.

Results

**Efficiency and demand focus prompts.** For all six items, participants in the efficiency and demand focus conditions responded to the initial prompts as expected. Compared with 1980, resources were seen as significantly more strained (all means higher than scale midpoint, *p*’s < .01). Conversely, production was seen as significantly more efficient compared with 1980 (all means higher than scale midpoint, *p*’s < .001).

**Real price estimates**. Averaging across conditions, participants believed that all the goods became more costly since 1980 (all *p*’s < .01). An Analysis of Variance (ANOVA) revealed a significant effect of the focus manipulation on evaluations of price changes (*F*(2, 294) = 5.22, *p* = .006, η*G2* = .034; see Figure 4). Follow-up ANOVAs revealed that priming an efficiency focus attenuated the extent to which participants thought costs had increased, relative to control; *F*(1, 196) = 7.53, *p* = .007, η*G2* = .037), whereas priming a demand focus had no effect (*F*(1, 195) < .01, *p* = .926, η*G2* < .001).

Notably, participants in the efficiency prime condition still believed that prices are increasing for refrigerators (*M* = 0.26, *SD* = 1.24; *t*(99) = 2.09, *p* = .039), chicken (*M* = 0.29, *SD* = 1.15; *t*(99) = 2.53, *p* = .013), and gasoline (*M* = 0.49, *SD* = 1.23; *t*(99) = 3.99, *p* < .001). Even when the efficiency prime eliminated the belief that prices are increasing, it did not lead participants to believe that prices are decreasing (eggs: *M* = 0.09, *SD* = 1.14; *t*(99) = 0.79, *p* = .431; tomatoes: *M* = 0.20, *SD* = 1.23; *t*(99) = 0.11, *p* = .107; electricity: *M* = 0.19, *SD* = 1.22; *t*(99) = 1.56, *p* = .123)



Figure 4: Study 3, beliefs about the amount of labor it took to afford various goods in 2018 relative to 1980, as a function of condition. Error bars are 95% CI.

Discussion

Priming people to consider what they already know about changes in production efficiency attenuates their belief that prices are increasing (to some degree). Priming people to consider changes in demand does not affect such beliefs. This supports our proposition that beliefs that prices are increasing are partly driven by intuitive focus on changes in demand, and an intuitive neglect of changes in productivity. However, study 3 also found that considering gains in production efficiency does not lead to the belief that prices are decreasing, and for some categories, is not even sufficient for eliminating beliefs in increasing prices. This suggests that efficiency neglect is only one of several factors underlying economic pessimism (an issue that we return to in the General Discussion).

**Study 4**

In Study 4, we examined how efficiency neglect affects beliefs about the impact of immigration on the economy. We suggest that when thinking about the impact of immigration, people intuitively focus on how immigration affects demand (that there will be more people in the country vying for goods) while neglecting the impact of immigration on efficiency (that there will be more workers participating in the production of goods). This may result in a view of immigration as a zero-sum – i.e., that economic benefits for immigrants come at the expense of current citizens. If true, asking people to consider how immigration affects the labor force should reduce the extent to which they perceive immigration as zero-sum. In contrast, asking people to consider how immigration affects demand should not affect immigration attitudes, because the impact of immigration on demand is already top of mind.

Of course, there are many reasons why people might be optimistic or pessimistic about immigration, some of which are unrelated to efficiency neglect or even to economics. For example, people may favor immigration because they think accepting immigrants is a moral duty, or oppose it because they think it causes culture clashes. Here, we are focused on how people think that increasing people will impact the abundance of things they consume.

Method

*Transparency and openness.* Sample sizes were determined prior to data collection. We report all manipulations, all measures, and do not exclude any participant who completed a study. Study materials and data are posted on the Open Science Framework (<https://osf.io/3uj8f/?view_only=f69f67e636b647eda92cfe3aa190fea6>).

Using Prolific, we recruited a nationally representative sample of 601 Americans (49% female, 50% male, 1% other; mean age 31). Study 4 employed a 3 between-participants conditions design (focus: efficiency, demand, control). In the efficiency focus condition, participants were asked to write about how immigration can increase the pool of available workers. In the demand condition, participants wrote about how immigration can increase the amount of food that is consumed. In the Control condition, participants were not asked to write anything.

Next, participants rated their agreement with 4 statements which measured the extent to which they thought of immigration as a zero-sum using 5-point scales that were adapted from prior research (Esses et al., 1998).

Results

We averaged the 4 immigration attitude items to form a single score of the degree to which participants viewed immigration as a zero-sum (*α* = .94). Consistent with our predictions, prompting participants to consider the effect of immigration on production efficiency reduced their belief that immigration is a zero-sum (*M* = 3.32, *SD* = 1.67 vs. *M* = 2.98, *SD* = 1.65; *t*(401) = 2.11, *p* = .035, *d* = .21), while prompting participants to consider the effect of immigration on demand had no effect (*M* = 3.32, *SD* = 1.67 vs. *M* = 3.33, *SD* = 1.65; *t*(411) = .02, *p* = .981, *d* < .00).

**General Discussion**

The idea that supply cannot keep up with demand as population increases is a persistent lay economic belief (Desrochers, 2020; Stokstad, 2005). Across millennia, thinkers from Plato to Malthus have argued that population growth will necessarily lead to fewer resources, and similar views are often marshaled to support protectionist sentiments and promote ideas such as closed borders and population control.

We identify efficiency neglect as a cause of depletionism: when thinking about the economic consequences of population growth, people spontaneously focus on changes in demand, while neglecting to consider changes in production efficiency that occur alongside, and often in response to, changes in demand. As a result, people believe that as the population grows, it becomes more difficult for the average worker to afford the same products. Put differently, people seem to intuitively think of additional people solely as consumers, overlooking their dual role as both consumers and producers. This leads to a failure to acknowledge the forces that push prices down, and to mistakenly believe that the real prices of goods today are much higher than they actually are, fostering a perception of continuous price increases even when there’s a significant drop. While the real costs of many consumer goods have dropped sharply over time, we show that people generally believe that costs are higher today than they were several decades ago, and that prices will continue to rise in the future.

Psychologists have long been interested in lay theories of scientific domains such as physics and biology (Keil, 2007; McCloskey & Kohl, 1983; Rozenblit & Keil, 2002). Far less work has examined how people think about economic forces (Leiser & Shemesh, 2018). This gap is unfortunate because lay economic beliefs are consequential (Day & Fiske, 2019; Roos, 2007, 2008). People that hold faulty beliefs about physics can still navigate the world without walking into walls. Faulty economic beliefs, however, can lead to harmful policy choices. Indeed, historically and today, they are often used to support destructive strains of populism across the political spectrum.

The present studies shed light on people’s intuitive understanding of economics and demonstrate the ways in which efficiency neglect may hold important implications for people’s depletionist theories. Moreover, to the extent that fears regarding economic decline are often used to support protectionist policies, we also present a relatively simple method of reducing this bias: simply prompting people to consider what they already know about gains in production efficiency over time may reduce their economic pessimism and reduce anti-immigration sentiment.

**Limitations and Future Directions**

It is important to note that the points we make in this paper are positive, not normative. We do not claim that life today is easier for everyone, that everything is more affordable, that prices will continue to drop indefinitely, or that people should be optimistic about the economy or about anything at all. We only show that people generally fail to consider how population growth has affected efficiency in the economy, and that this leads them to underappreciate the forces that push prices down. While this point is illustrated most starkly when people believe that prices are increasing even as prices really are decreasing, this mismatch is merely a consequence of the mechanism we uncover, and not necessary for it to hold. Efficiently neglect occurs whenever people fail to consider efficiency changes and regardless of whether prices are falling or not.

Relatedly, we chose which items to include in our studies based on whether they were tracked by the BLS or appeared in different issues of the Sears catalog and are reasonably comparable across decades.[[4]](#footnote-4) We do not claim that those items represent the whole economy. Whereas the real prices of food and other basic goods have generally decreased, other things - notably ones whose price is largely independent of production efficiency such as services, non-fungible goods, premier education, and real estate - have often gotten more expensive. We claim that efficiency is generally neglected. We do not claim that efficiency made everything cheaper for everyone.

*Constraints on Generality.* A limitation of the current investigation is our use of only American samples. Because we were interested in comparing beliefs to the actual changes in the costs of goods over time, it was necessary to focus on one only country (in this case, the U.S.). As a result, we are limited in our ability to generalize these findings to other populations/nations. That said, international polling suggests that general economic pessimism is a global phenomenon (Deloitte, 2019). More research is needed to determine whether such widespread pessimism does indeed have common psychological causes.

A second limitation of the present studies is that efficiency neglect appears to be only a partial explanation of depletionism and its consequences for economic beliefs. Studies 2a, 3 and 4 demonstrated that while prompts to consider production efficiency attenuate depletionist thinking, they do not lead the majority of respondents to judge that more people will mean more abundance and cheaper goods. One explanation may simply be that depletionist ideas are “sticky” and robust to informational interventions. A second may be that depletionsim is multiply determined. Indeed, we note other phenomena in the Introduction that may contribute to the belief that costs are rising, e.g., confusing inflation with cost-of-living and zero-sum reasoning. Depletionism and economic pessimism may also reflect a general negativity bias (Soroka, Fournier, & Nir, 2019): there is a human tendency to be more attentive to negative news, which in turn favors negative news content. Thus, people are likely exposed to negatively-biased stories about the economy. These factors may exert a powerful effect on people’s judgments such that they are reluctant to say that costs of consumer goods have decreased historically, or that they will be cheaper in the future. Analogously, anti-immigration sentiment clearly has other causes besides depletionism (Dennison & Geddes, 2019; Fetzer, 2000).

Finally, the present studies may have interesting applications to other literatures, such as those which aim to better understand political differences. As noted earlier, economic lay theories differ from lay physics or lay biology in that they may have many real-world consequences for political attitudes or voting behavior. Note, however, that depletionism per se is not a partisan belief, and different groups may be motivated to exploit efficiency neglect for different political ends. Some of our examples include anti-immigration attitudes, which may be thought of as right-wing, but efficiency neglect can also be used to support policies more likely found on the political left such as population control and, more generally, to push toward a command-and-control economy. Understanding the role of such motivated processes, especially in highly-politicized domains, may prove informative as they, too, may be an important reason why depletionist beliefs persist.

Depletionism is fascinating. It is a belief that has persisted across the world throughout the ages in face of ample contradictory evidence. Population levels have risen beyond what many depletionists throughout history could have imagined, and so has abundance. And yet, depletionism persists. We hope the present studies are a first step toward uncovering its psychological foundations.

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1. Order of authorship is alphabetical. The ideas in this manuscript and data from some of the studies (1a, 3, and 4) were presented in research seminars for the Data Colada Seminar Series, the DMEP seminar at Ben-Gurion University, the DR@W seminar at Warwick University, and the Four Schools Marketing Conference. Materials for all studies can be found in the Supplemental Materials. All data are available at: https://osf.io/3uj8f/?view\_only=f69f67e636b647eda92cfe3aa190fea6 [↑](#footnote-ref-1)
2. We use the term “average worker” to refer to the Board of Labor Statistics’ “production and nonsupervisory employees on private nonfarm payrolls,” about which average hourly wage data has been collected for many decades. [↑](#footnote-ref-2)
3. Due to sharp increases in the income of the wealthiest Americans, including them in our average income calculations may overstate how much wages increased for the average American. We avoid this by basing our calculations on the average wage of American nonsupervisory and production workers, which includes laborers in sectors such as retail, manufacturing and construction. [↑](#footnote-ref-3)
4. For instance, apples and oranges today could be reasonably compared to apples and oranges in the 1980’s, but personal computers and medical services could not. A basic modern laptop was beyond imagination in 1980, and it would be highly unethical to provide modern patients state-of-the-art 1980’s medicine. [↑](#footnote-ref-4)