Introduction of a harm reduction method:

When does it help and when does it backfire?

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Overview

Some **harm reduction strategies**

- **Switch** from harmful to less harmful addictive goods
  - e.g. from cigarettes to vaping

Controversial strategy

- Advocates claim improves health
- Opponents wary of moral hazard and new initiation

This paper: a theoretical model

- Introduction of an addictive harm reduction method
- Conditions under which each side correct

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Is it an interesting question?

Substantial morbidity and mortality associated with **addictive behaviors**

- WHO (2022) estimates, worldwide:
  - 8 million deaths/year from smoking
  - 3.3 million deaths/year from alcohol use disorder
  - 500,000 deaths/year from drug overdose

Nations have sought to reduce risky health behaviors

- One approach: **harm reduction** (Erickson, 1995)

Definition of Harm Reduction

In general: "harm reduction" describes many approaches

- e.g. needle exchange, supervised injection facilities, condom distribution, naloxone access laws, Good Samaritan laws, legalized prostitution (e.g. SAMHSA, 2021)

Here: focus on harm reduction methods that are:

1. **Substitutes** for existing addictive good
2. Believed to be **less harmful**

- Consistent with
  - "Public health policies … to decrease negative consequences … without requiring abstinence" (Harm Reduction International NGO, 2021)
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Relevance for policy

Effectiveness of harm reduction methods is **controversial**

Advocates claim will reduce health harms

- Could aid **quitting** (by helping phase out)

Opponents concerned about moral hazard

- Could worsen health harms among **existing users**, reduce quits
- Could lead **abstainers** to initiate harm reduction method
  ... and initiate original addictive good (worst case scenario)

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Ambivalent policies

- In 2019, U.S. *raised minimum age* to purchase e-cigarettes from 18 to 21
- In 2021, FDA *authorized* marketing of e-cigarettes
  - .. but in 2022, FDA *denied* the marketing of Juul ENDS products
- 32 nations (e.g. Australia, Brazil, Cambodia, India, Japan, Mexico, Thailand) have banned ENDS (WHO, 2021)

- Electronic nicotine delivery systems (ENDS) sometimes more tightly regulated than combustible cigarettes
  - Worldwide: regulations range from totally unregulated to regulated as pharmaceutical products (WHO, 2021)

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Ambivalent policies (2)

- Variation in taxation of e-cig
  - in U.S., 21 states don't tax at all
  - in those that tax, rates range from 8% (NH) to 95% (MN) (IGEN, 2021)

- Buprenorphine more tightly regulated than opioid pain relievers (that contributed to U.S. opioid overdose epidemic)
  - Physicians must take 8 hours training & obtain DEA waiver before prescribing;
  - In 2018 40% of US counties had zero waivered providers (Pew, 2021)
  - May only prescribe to 30 patients 1st year, 100 patients in subsequent years (Waters, 2019)
  - Many insurers (including some states' Medicaid) require prior authorization

Our contribution

1. A model of addictive consumption
   - Demand for harm reduction method
     - Addictive
     - Harmful (although less than original addictive good)
   - Before and after introduction of method of harm reduction

2. Demonstrate conditions under which introduction of harm reduction method:
   - Improves or worsens **health**
   - Leads previous **users** to quit the original addictive good
   - Leads previous **non-users** to begin using the harm reduction method
     - ... and eventually also the original addictive good

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Useful to better understand

Risk compensation and moral hazard in health behaviors Doleac, Mukherjee (2022), Frio et al. (2021), Dave et al. (2019), Cotti et al. (2019), Simon et al. (2017), Margolis et al. (2014), Bhattacharya et al. (2012)

ENDS as substitute for cigarettes Cotti et al. (2021), Allcott, Rafkin (2020); Pesko, Courtemanche, and Maclean (2020), Marti et al. (2019), Abouk et al. (2019), Pesko and Currie (2019), Friedman (2015)

Economic studies of of methadone and buprenorphine Doleac, Mukherjee (forthcoming), Allen et al., (2022), Maclean et al. (2021), Barrette et al. (2021), Rees et al. (2019), Abouk et al. (2019), Bishai et al. (2008)

Rational addiction and self-control Becker, Murphy (1988), Gul, Pesendorfer (2004), Loewenstein, O'Donoghue (2004), Fudenberg, Levine (2006), Dragone, Raggi (2021), Alcott et al. (2023)

A model of harm reduction

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Two goods:

c Addictive good
v Harm reduction method

Both **addictive**

- Addiction stock A
  - same receptors in the brain
  - v typically less addictive

$$\dot{A} = c + \varepsilon_A v - \delta_A A$$
$(\varepsilon_A > 0)$
$(\varepsilon_A < 1)$

Both **harmful**

- Health harm H
  - v less harmful (per unit of consumption) than c
  - past consumption A harms health

$$\dot{H} = c + \varepsilon_H v + \omega A - \delta_H H$$
$(\varepsilon_H \in (0,1))$
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Utility function

Instantaneous utility $U(c, v, q, A, H)$
(q a non-addictive composite good)

1. Consuming is pleasurable $U_c, U_v > 0$
2. ... but addiction and health harm are bad $U_A, U_H < 0$

3. Reinforcement (Becker, Murphy, 1988) $U_{cA} > 0, U_{vA} > 0$

Utility function

To obtain close-form solutions → Quadratic utility function

$$
\begin{aligned}
\mathcal{U}(c, v, q; A, H) &= u_c c + u_v v + q && (\textit{desirability}) \\
&+ u_{cA} cA + u_{vA} vA && (\textit{addictiveness}) \\
&+ u_A A + u_H H && (\textit{harmful}) \\
&+ \frac{u_{AA}}{2} A^2 + \frac{u_{HH}}{2} H^2 + \frac{u_{cc}}{2} c^2 + \frac{u_{vv}}{2} v^2 && (\textit{concavity})
\end{aligned}
$$

The intertemporal problem

Solve

$$\begin{aligned} \max & \int_0^\infty e^{-\rho t} \mathcal{U}\left(c, v, q, A, H\right) \mathrm{d}t \\ \text{s.t. } & \dot{A} = c + \varepsilon_A v - \delta_A A \\ & \dot{H} = c + \varepsilon_H v + \omega A - \delta_H H \\ & M = p_c c + p_v v + q \end{aligned}$$

Trade-offs

- c, v increase addiction A and harm H
- Addiction A: Increases marginal utility of c, v ... which further **pushes** consumption

  ... but also increases health harm H ... which instead **deters** consumption

Two scenarios

Before introduction of harm reduction method

1. Only one addictive good is available
2. Who consumes and who does not?

After introduction of harm reduction method

1. How do **users** of addictive good respond?
   - More addictive consumption? Less?
   - Dual consumption? Cessation?
2. How do **non-users** respond?
   - Initiation?
3. Is overall **harm reduced**?

Scenario 1

Before the introduction of a harm reduction method

Scenario 1: One addictive good is available

Optimal consumption path: $c = a_0 + a_A A + a_H H$

Note:

1. $a_0 = a_c c^{ss}(p)$ is long-run consumption
   - a negative function of price!
   - useful for empirical estimation
2. Linear policy function ... and yet oscillatory consumption is possible!

Benchmark: One addictive good is available

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Stationary consumption: $c^{ss} = \alpha\left(u_c - p_c - \pi_c\right)$
with $\alpha > 0$

Prediction
Addictive consumption **more likely** when
- u_c (Unconditionally) desirable
  - appreciation (+), stigma (-)
- p_c Monetary cost is low
  - price (-), taxes (-), subsidies (+)
- π_c (Perceived) Disutility of addiction and harm is low
  - awareness about health harm (-)

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Scenario 2:

After the introduction of a harm reduction method

Who consumes the harm reduction method v?

Stationary consumption: $v_d^{ss} = \alpha_d \left(u_v - p_v - \pi_v \right) + \zeta c^{ss}$

with $\alpha_d > 0$; $\zeta > 0$ (if u_{vA}, u_{cA}, u_{vc} small)

Same logic as for original addictive good

v_d^{ss} **more likely** when

1. More appealing (u_v)
2. Low monetary cost (p_v) and (perceived) disutility of addiction and harm (π_v)

   +
3. A previous (and heavy) user of the addictive good c (i.e. $c_{ss} > 0$)

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Policy question

Should a harm reduction method be allowed on the market?

- i.e. effect of availability of v on c and H?

Addictiveness of the harm reduction method: **three** cases

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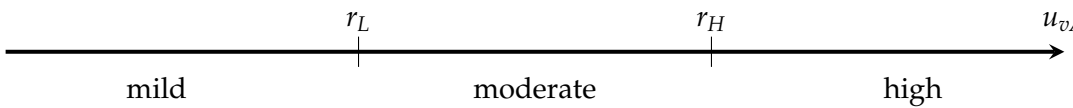

Response of original addictive good c

Stationary consumption: $\Delta c = c_d^{ss} - c^{ss} = \theta_c \left(u_{vA} - r_H\right) v_d^{ss}$

Suppose $v_d^{ss} > 0$

More c if v is *highly* addictive (i.e. $u_{vA} > r_H$)

- for users ($c^{ss} > 0$): **dual consumption**
- non-users ($c^{ss} = 0$): possible **initiation**

Less c if v *not* highly addictive (i.e. $u_{vA} < r_H$)

- for users: **substitution** between c and v
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Note: r_H is higher the greater the substitutability u_{vc} of v for c

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Addictiveness as key driver

Potentially risky

- Methadone
  - sufficiently addictive that must be dispensed in clinics
  - can't trust patients to have big supply at home
- Vaping
  - just as addictive as smoking
  - tech allows you to consume nicotine faster

Seems good

- Buprenorphine for opioids
  - widely seen as safer
  - patients given supply to take home

... and what about health harm?

Note: In terms of harm reduction, this may be the relevant target

In the long run: $\Delta H = \theta_H \left(u_{vA} - r_L\right) v_d^{ss}$
with $\theta_H > 0, r_L \in (0, r_H)$

Suppose $v_d^{ss} > 0$

- **More** harm if v is *moderately* or *highly* addictive ($u_{vA} > r_L$)
- **Less** harm if v is *mildly* addictive ($u_{vA} < r_L$)

Key insight: r_L is higher the greater the substitutability of v for c: U_{vc}

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To sum up

Recall:

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Hence:

Harm reduction method used?	Addictiveness of harm reduction method: Mild	Moderate	High

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No	**Harm reduction method irrelevant** $v^{ss} = 0$; c^{ss} and H^{ss} remain unchanged		

Policy implications

If harm reduction method is not desirable enough

- Not good (no decrease in c)
- ... but also not bad (no change in H, A)

If it is desirable

- Current users are more likely to use (everything else equal)
- .. and non-users might start using

- Key variables
  - Appreciation (+), stigma (-), price (-), taxes (-), awareness about harms (-)
  - Similar to antismoking policies

When does it help and when does it backfire?

1. Less consumption and health harm if **mildly** addictive
   - Advocates are right
   - → Harm reduction **helps**

2. More consumption *and* harm if **highly** addictive
   - Opponents are right
   - → Harm reduction **backfires**

3. "Nuanced" answer if **moderately** addictive
   - Less consumption, *but* more harm

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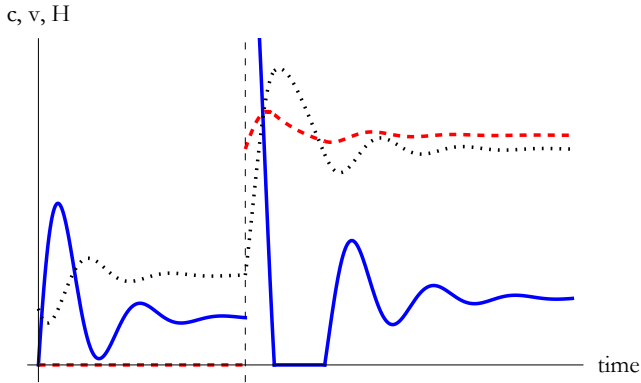
Graphically: 3 Cases

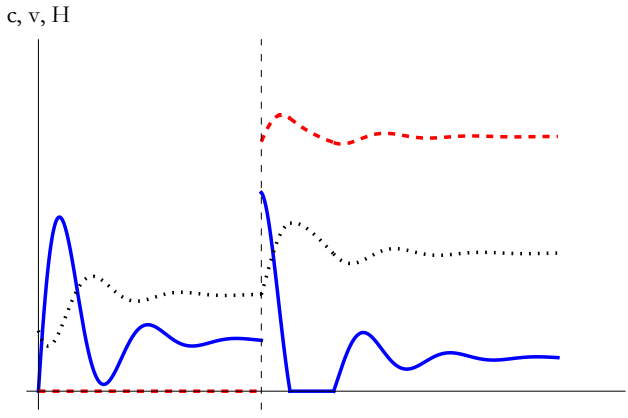
1. v is highly addictive
   - Both health harm and addictive consumption **increase**
   - Worst case scenario
     - **Opponents** of harm reduction are right
2. v is moderately addictive
   - Addictive consumption decreases
   - ... but health harm **increases**
3. v is mildly addictive
   - Both health harm and addictive consumption ultimately **decrease**
   - ... through substitution with harm reduction method
     - **Advocates** are right

1. High addiction



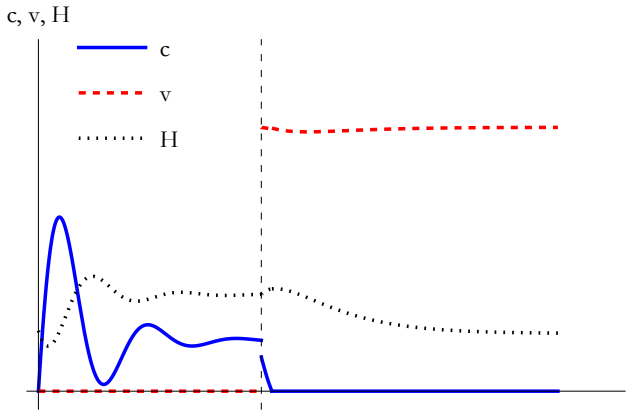
- **More** addictive consumption and health harm
- Worst case scenario

2. Moderate addiction



- **Less** addictive consumption, with quits and relapses over time
- But **more** health harm

3. Mild addiction



- **Quitting** addictive consumption
- **Substitution with** the harm reduction method ...

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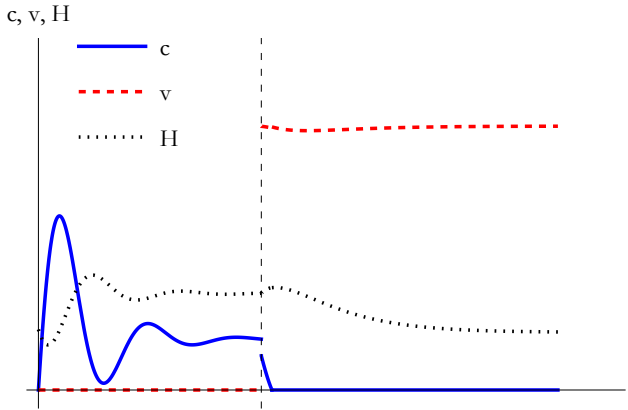

- ... ultimately **less** health harm, consumption and addiction

Policy justification and dual-self model

Why policy intervention?

- Paternalism
- Temptation and costly self-control

A dual-self model

- Short-run self: tempting choice $\tilde{c}(A, H)$
- Long-run self:

$$\max V = \int_0^\infty e^{-\rho t} \{U(c; A, H) - B[\tilde{c}(A, H) - c(A, H)]\}\, dt$$

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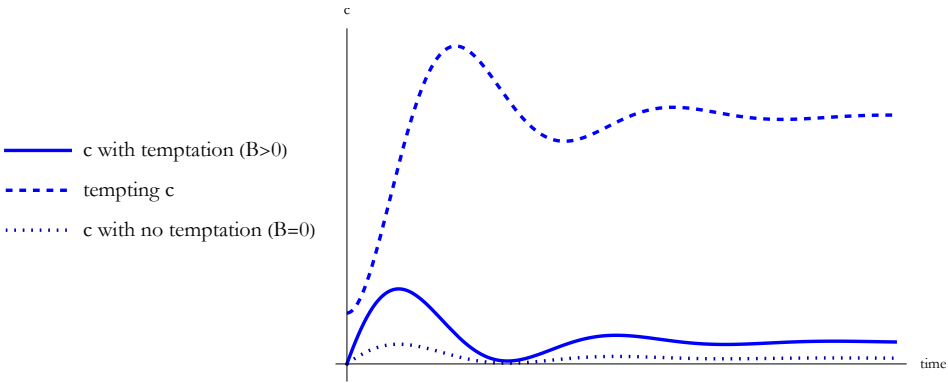
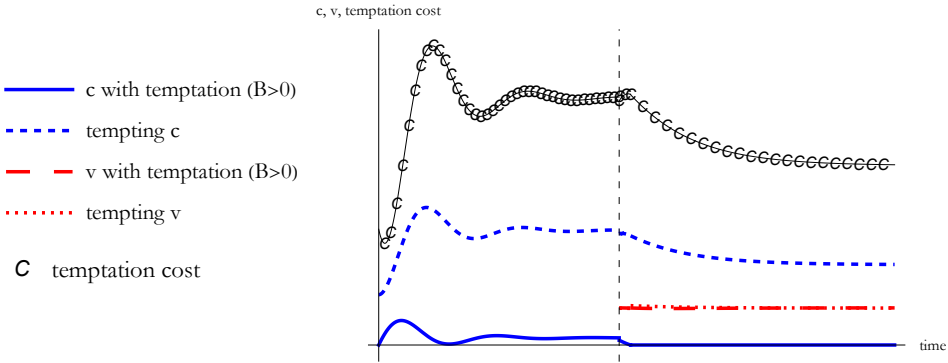
Effect of temptation



Temptation costs

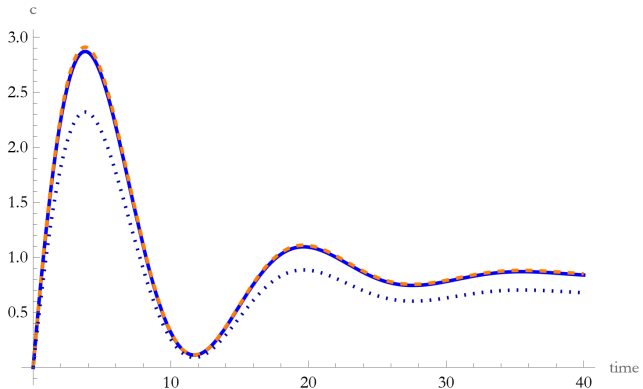


Pigouvian taxation

c with temptation (B>0)

c with temptation and pigouvian tax

c with no temptation (B=0)



Conclusions

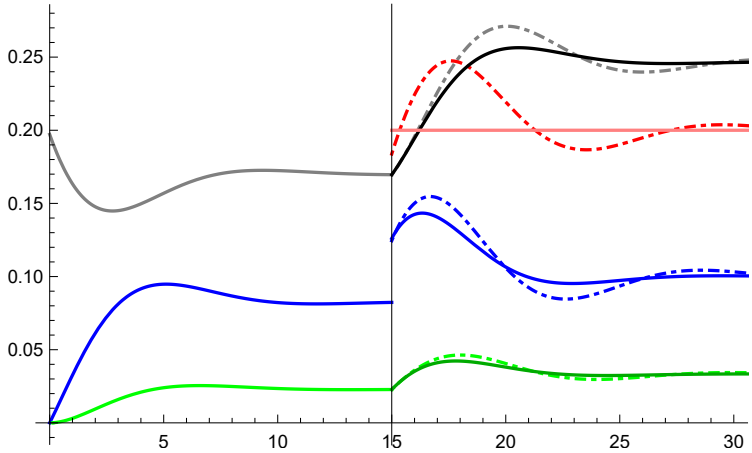
Model that determines conditions under which introduction of harm reduction

- facilitates quitting and improves health, or
- worsens health and leads abstainers to start using the addictive good

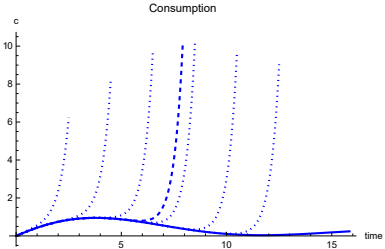
Neither advocates nor opponents always right; either possible depending on conditions

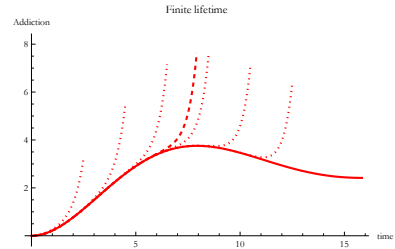
- Key factors (which can be influenced by policy):
  - enjoyableness and addictiveness of harm reduction method
  - substitutability of harm reduction for original addictive good

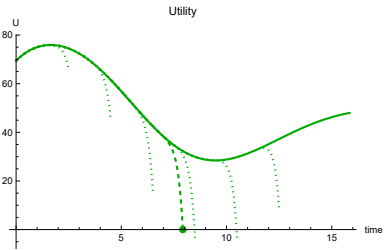
Regulated consumption of v

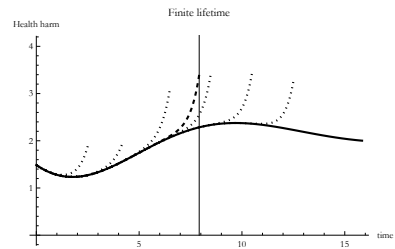


Finite time-horizon









Discussion: Policy levers

- Whether to allow harm reduction method on market (e.g. FDA review)
- Limit quantity of v in other ways
  - Methadone only dispensed in Opioid Treatment Programs (clinics)
  - Make Rx, restrictions on purchase amount of THC edibles
- Alter addictiveness:
  - Limit potency of buprenorphine doses, amount of THC, amount of nicotine by e-cigs
- Alter "enjoyableness" for those who abstained from original addictive good, ideally while keeping it enjoyable for previous users of addictive good:
  - Reduce marginal utility: U.S. FDA banned flavored e-cigs, NJ allows edibles as capsules but not brownies/cookies
  - Raise costs (time and money): minimum purchase age, tax, make Rx rather than OTC
- Tradeoff: r_H and r_L are lower when v is closer substitute for c