CBDC and Payment Platform Competition

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Introduction

Many central banks consider introducing retail CBDCs

Main research focus:

- CBDC as a means of payment, similar to FPS - public fast payment scheme
- impact of introducing a public platform competing with private platforms

Main questions:

- How is it different from competition between private platforms?
- What is the impact on competition, financial inclusion, and overall welfare?
- What would be the optimal pricing of the CBDC payment platform?

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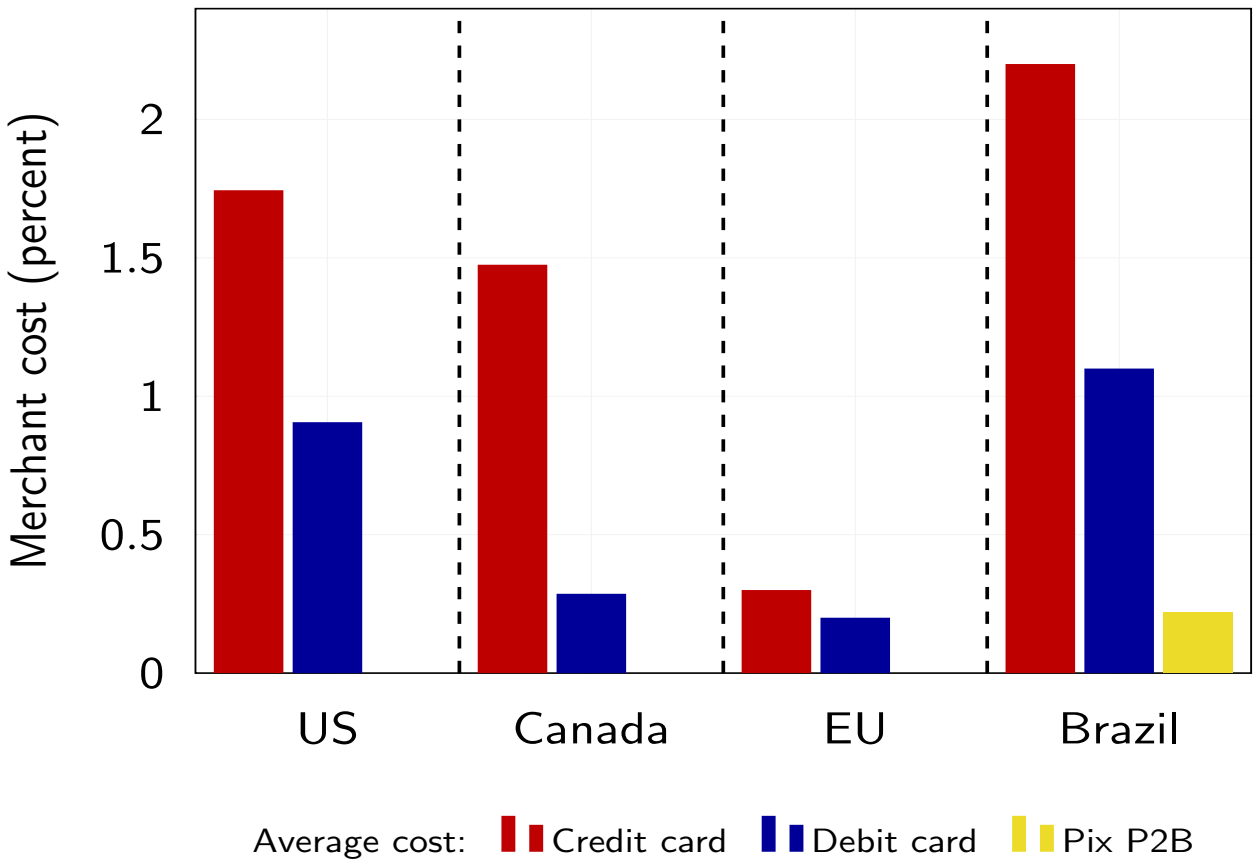
The Payments Market

Features: Two-sided and oligopolistic

Main issue focused: high card fees



Source: Duarte et. al, BIS Report, March, 2022.

Overview

We build: Two-sided platform model of competition (network level)

CBDC as a payment platform *competitor* that:

- is differentiated in terms of benefits
- maximizes welfare, while facing constraints from marketplace practices

We find:

- Private platforms charge excessive fees due to market power and network effects
- CBDC increases competition and improves overall welfare even if it generates weaker benefits to users
- CBDC's optimal pricing balances the trade-off between gaining traction and accommodating users' heterogeneous preferences

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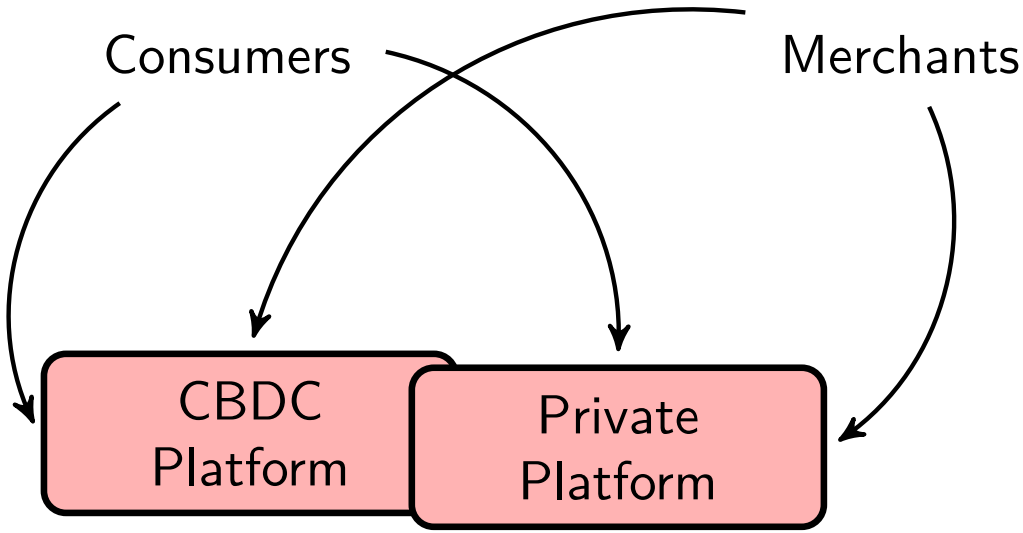
Literature

- **Two-sided markets:**
  Theory: Baxter (1983); Rochet and Tirole (2003,2006); Schmalensee and Evans (2005); Chakravorti and Roson (2006); Armstrong (2006); Hagiu (2006); Guthrie and Wright (2007); Rysman (2009); Weyl (2010); White and Weyl (2016); Jain and Townsend (2020).
  Recent Empirical: Bedre-Defolie et al. (2018); Felt, Hayashi, Stavins and Welte (2021); Huynh, Nicholls and Shcherbakov (2022); Halaburda, Kim and Shcherbakov (2022).
  Add: Benevolent payment platform

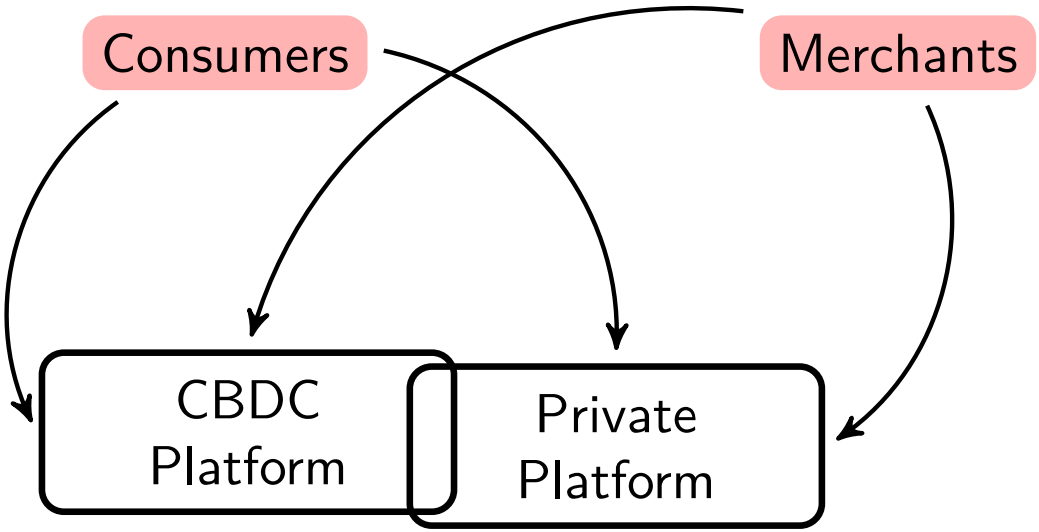
- **CBDC:**
  Keister and Sanches (2019), Brunnermeier and Nielpelt (2019);
  Chiu et al. (2020); Fernandez-Villaverde et al. (2020); Keister and Monnet (2020); Niepelt (2020); Piazzesi and Schneider (2021); Verdier (2021).
  Add: CBDC as a two-sided payment platform; IO perspective on CBDC.

The Setup



- Platforms compete on prices: p_i^c, p_i^m
- Difference:
  - Private platform maximizes its profit.
  - CBDC platform maximizes total welfare.

The Setup



- Two benefits received from joining:
  1. **network benefit** per-transaction: b_i^c, b_i^m
  2. **idiosyncratic membership benefit**: $v_i^c \sim F_c(v)$, $v_i^m \sim F_m(v)$
- Assumptions: b_i^c, $b_i^m \geq c_i$ and $F_c(v)$, $F_m(v)$ are log-concave

End-users' problems

- Consumers choose only one of the payment networks (**singlehome**)

$$u_c(\vec{p}_1, \vec{p}_2) = \max\{ \underbrace{v_0^c}_{\substack{\text{Outside} \\ \text{option}}}, \underbrace{v_1^c + b_1^c N_1^m - p_1^c}_{\text{Platform 1}}, \underbrace{v_2^c + b_2^c N_2^m - p_2^c}_{\text{Platform 2}} \}$$

- Merchants can choose both payment networks (**multihome**)

$$u_m(\vec{p}_1, \vec{p}_2) = \max\{ \underbrace{v_0^m}_{\substack{\text{Outside} \\ \text{option}}}, \underbrace{v_1^m + b_1^m N_1^c - p_1^m}_{\text{Platform 1}} \} + \max\{ \underbrace{v_0^m}_{\substack{\text{Outside} \\ \text{option}}}, \underbrace{v_2^m + b_2^m N_2^c - p_2^m}_{\text{Platform 2}} \}$$

Consumers bring network benefits to merchants and vice versa;

Neither side internalizes this benefit.

Socially optimal pricing

Social planner maximizes social welfare

$$\max_{\vec{p}_1,\vec{p}_2} \underbrace{V_m(\vec{p}_1,\vec{p}_2)}_{\text{Merchant Surplus}} + \underbrace{V_c(\vec{p}_1,\vec{p}_2)}_{\text{Consumer Surplus}} + \sum_{i\in\{1,2\}} \underbrace{p_i^c N_i^c + p_i^m N_i^m}_{\text{Revenue}} - \underbrace{c_i N_i^c N_i^m}_{\substack{\text{Transaction}\\ \text{Costs}}}.$$

The socially optimal pricing is:

$$\begin{aligned} p_i^c &= \underbrace{c_i N_i^m}_{\text{Transaction Costs}} - \underbrace{b_i^m N_i^m}_{\text{Network Benefits}}; \\ p_i^m &= \underbrace{c_i N_i^c}_{\text{Transaction Costs}} - \underbrace{b_i^c N_i^c}_{\text{Network Benefits}} \end{aligned}$$

Intuition:

- A social planner internalizes network benefits on both sides by passing these benefits to each side through subsidies

Private platform pricing

In the unique equilibrium of competition between private platforms, both platforms set prices at

$$\begin{aligned} p_i^c &= (c_i - b_i^m)N_i^{m,FB} + \mu_i^c + (c^i - b_i^m)(N_i^m - N_i^{m,FB}); \\ p_i^m &= \underbrace{(c_i - b_i^c)N_i^{c,FB}}_{\text{Socially Optimal Price}} + \underbrace{\mu_i^m}_{\text{Market Power}} + \underbrace{(c^i - b_i^c)(N_i^c - N_i^{c,FB})}_{\text{Scale Distortion}}; \end{aligned}$$

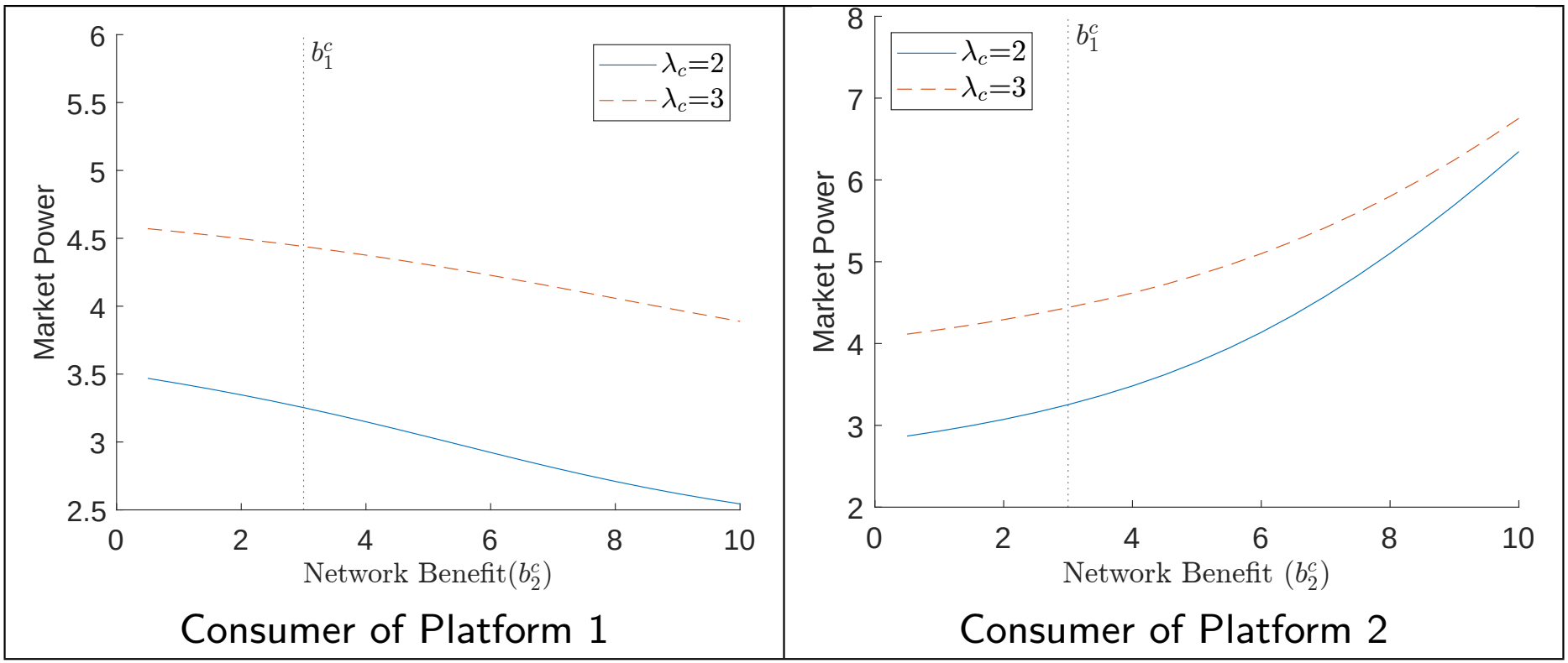
Two distortions:

- Market Power (+): due to platform differentiation.
- Scale Distortion (+/-): under/over incentivise usages due to network effects.

Price Distortions: Market Power

Market power of a platform ($\mu_x^i, \in \{c, m\}$):

- $\downarrow$ if competing platform's network benefits $(b_x^j)\uparrow$
- $\uparrow$ if its own network benefits $(b_x^i)\uparrow$and user heterogeneity (λ_x) $\uparrow$;

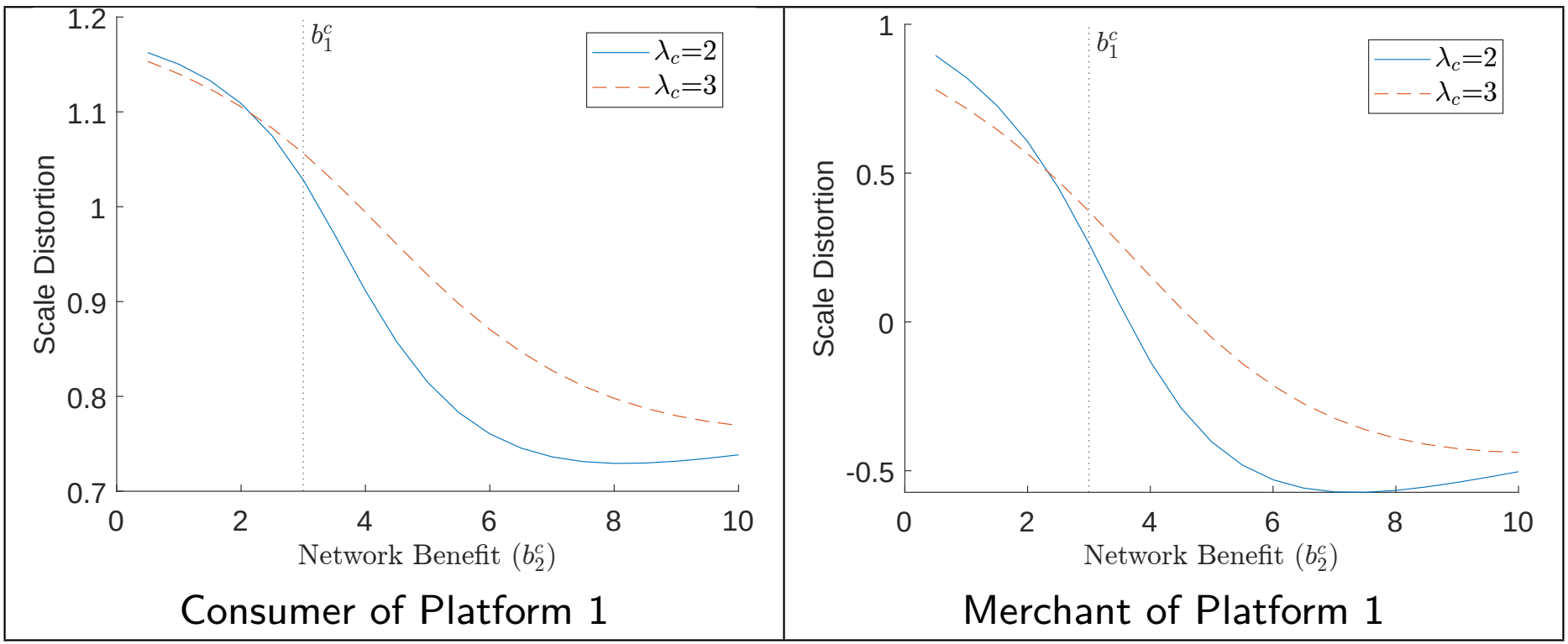


Market Power on Merchant Side

Price Distortions: Scale Distortion

- consumer side: always positive
- merchant side: negative when network benefits are relatively lower

Scale Distortion



Change with merchant benefit

Introduce CBDC platform

The CBDC (platform 1) maximizes social welfare:

$$\max_{p_1^m, p_1^c} \text{Welfare} = \underbrace{V_m(\vec{p}_1, \vec{p}_2)}_{\text{Merchant Surplus}} + \underbrace{V_c(\vec{p}_1, \vec{p}_2)}_{\text{Consumer Surplus}} + \underbrace{\sum_{i \in \{1,2\}} \pi_i(\vec{p}_1, \vec{p}_2)}_{\text{Profits}}.$$

while private platform (platform 2) maximises its profit:

$$\max_{p_2^m, p_2^c} \Pi_2 = p_2^m N_2^m + p_2^c N_2^c - c_2 N_2^m N_2^c.$$

CBDC pricing

In the unique equilibrium of competition between a benevolent and a private platform, the benevolent platform sets:

$$p_1^c = (c_1 - b_1^m)N_1^{m,FB} + (c_1 - b_1^m)(N_1^m - N_1^{m,FB}) + \underbrace{\mu_c^2 \eta_c^1}_{\text{Benevolent adjustment}}$$

$$p_1^m = \underbrace{(c_1 - b_1^c)N_1^{c,FB}}_{\text{Socially optimal Price}} + \underbrace{(c_1 - b_1^c)(N_1^c - N_1^{c,FB})}_{\text{Network effect adjustment}}$$

$\eta_c^1 \equiv -\frac{\partial N_c^2 / \partial p_c^1}{\partial N_c^1 / \partial p_c^1}$ - diversion ratio: the fraction of consumers that switch from one product to an alternative after a price increase.

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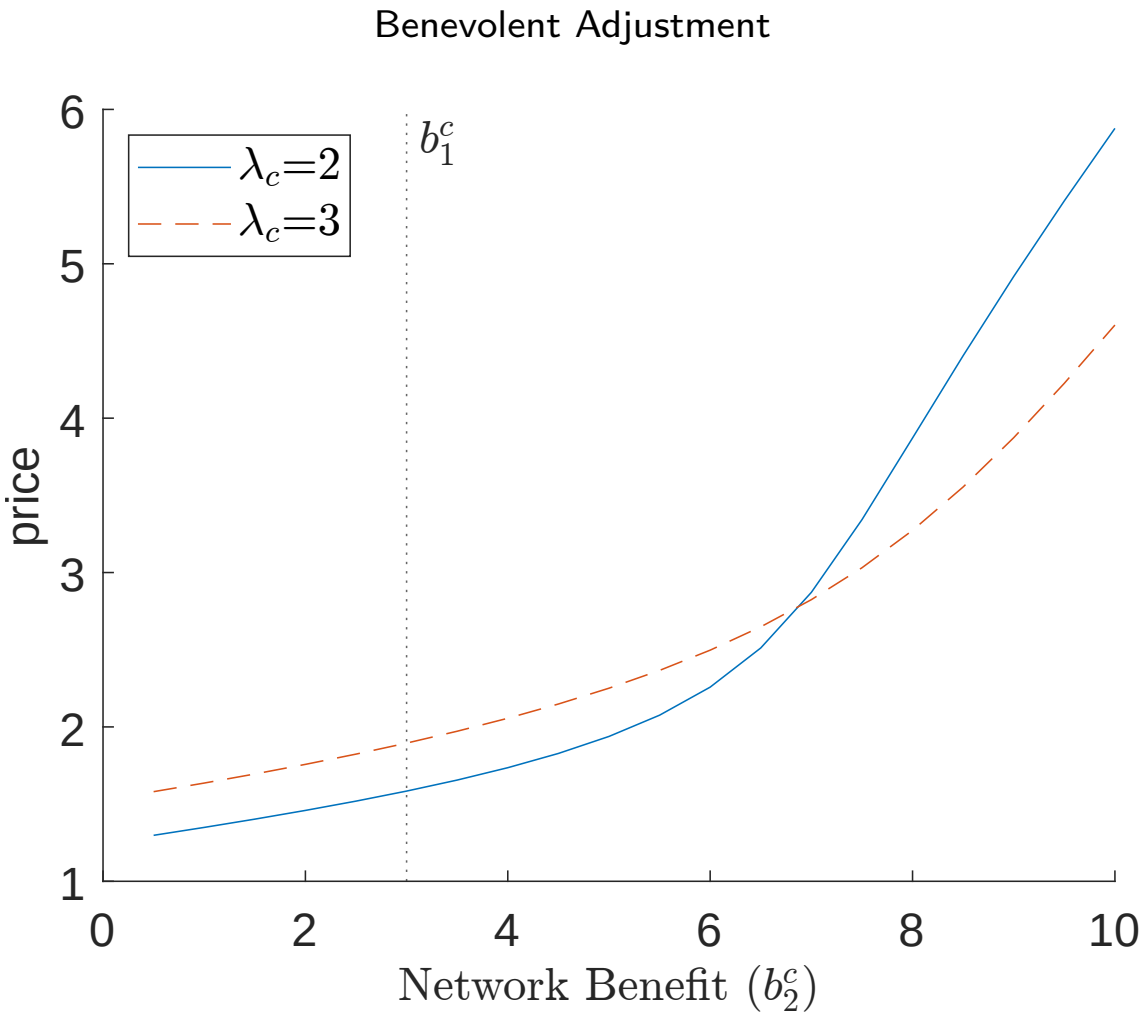
- Benevolent Adjustment: accounts for network effects of the private platform
- Trade-off: Lowering prices to increase competition vs. ensuring adequate network effects of the private platform

Benevolent Adjustment

CBDC platform ↑ benevolent adjustment to mitigate competitive effect if network effects of private platform ↑



Change with merchant benefit

Impacts of introducing CBDC

- **Competitive effect:** induces the private platform to lower consumers' fee but not necessarily the merchants' fee details
- **Financial inclusion:** induces more participation by end-users, but lower than the socially optimum details
- **Social welfare:** improves market efficiency even with lower benefits, but less than the socially optimum details

Conclusions

We study CBDC as a means of payment:

- Benevolent, i.e., welfare-maximising
- Competing with a private platform

A benevolent CBDC platform:

- offers an improvement over the purely private platform outcomes
- does not achieve the social optimum

CBDC pricing balances the trade-off between:

- increase competition and
- ensure adequate network effects

Price Distortions: Market Power (Merchant)

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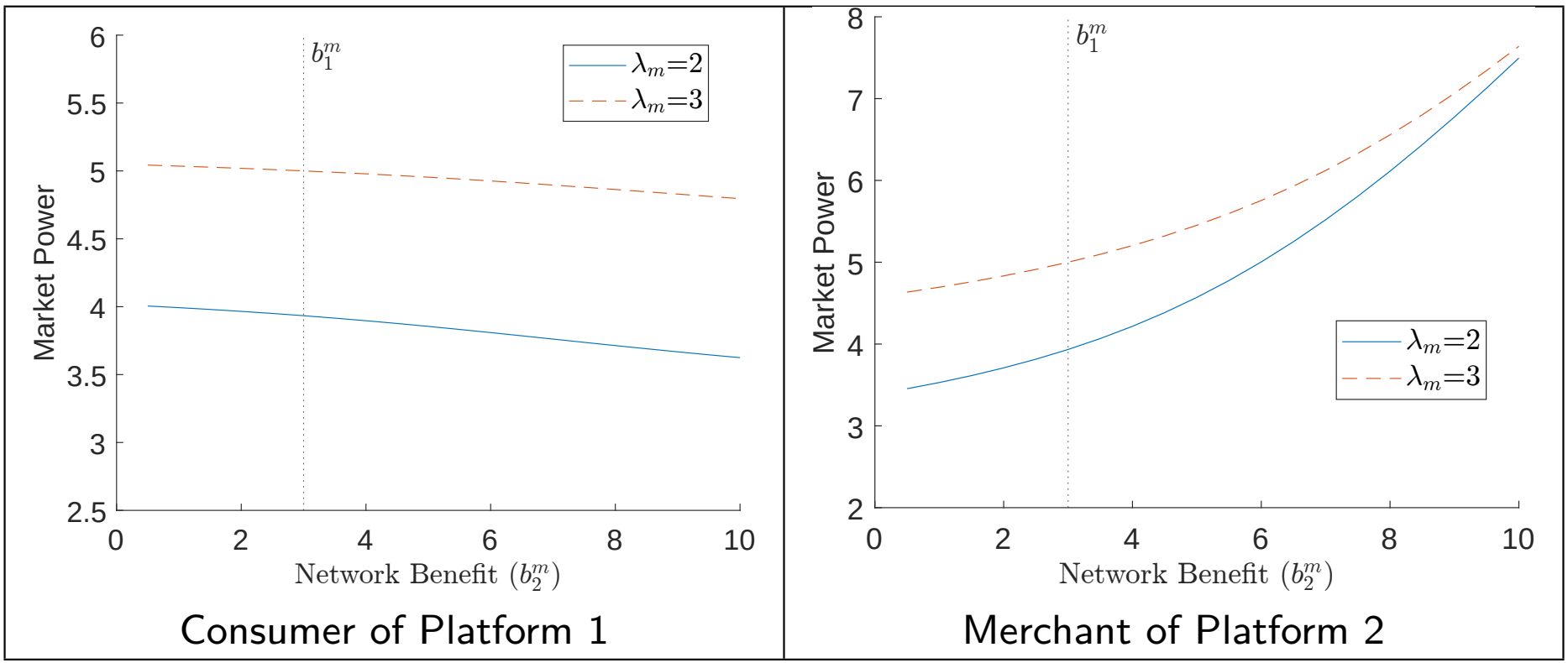

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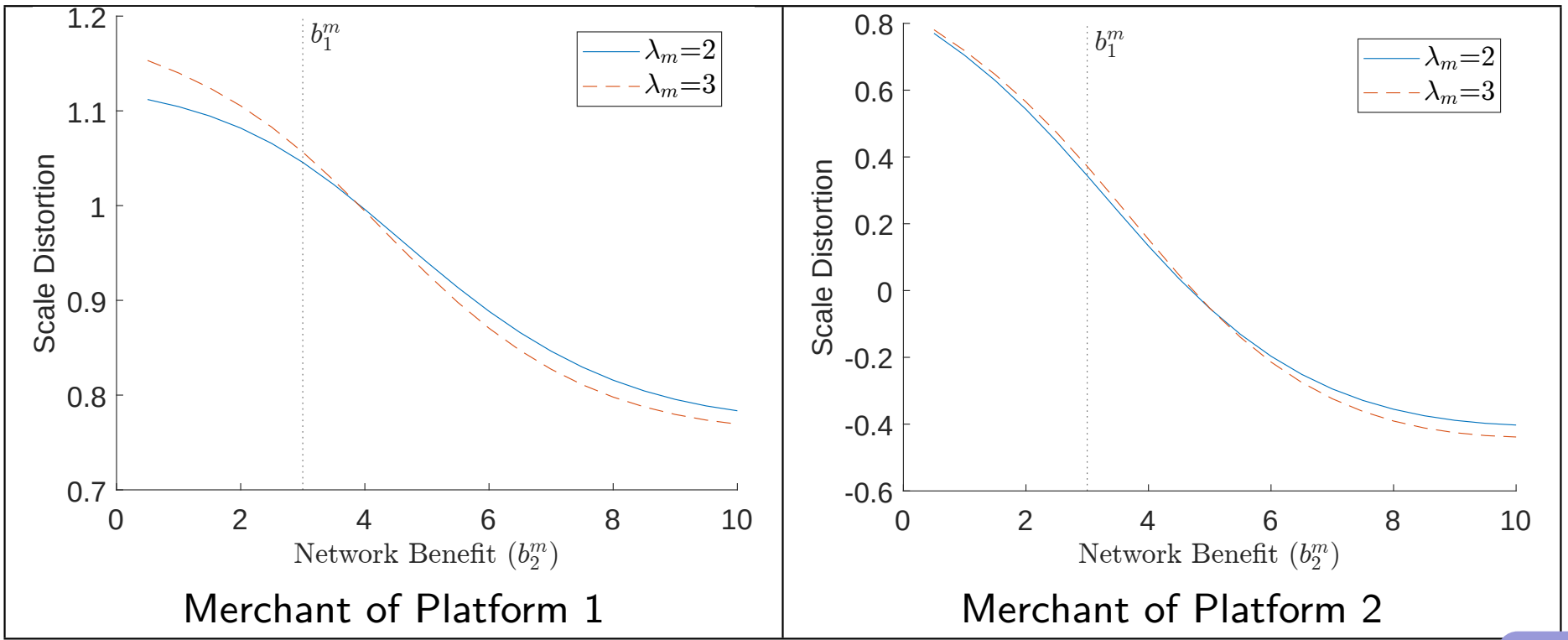

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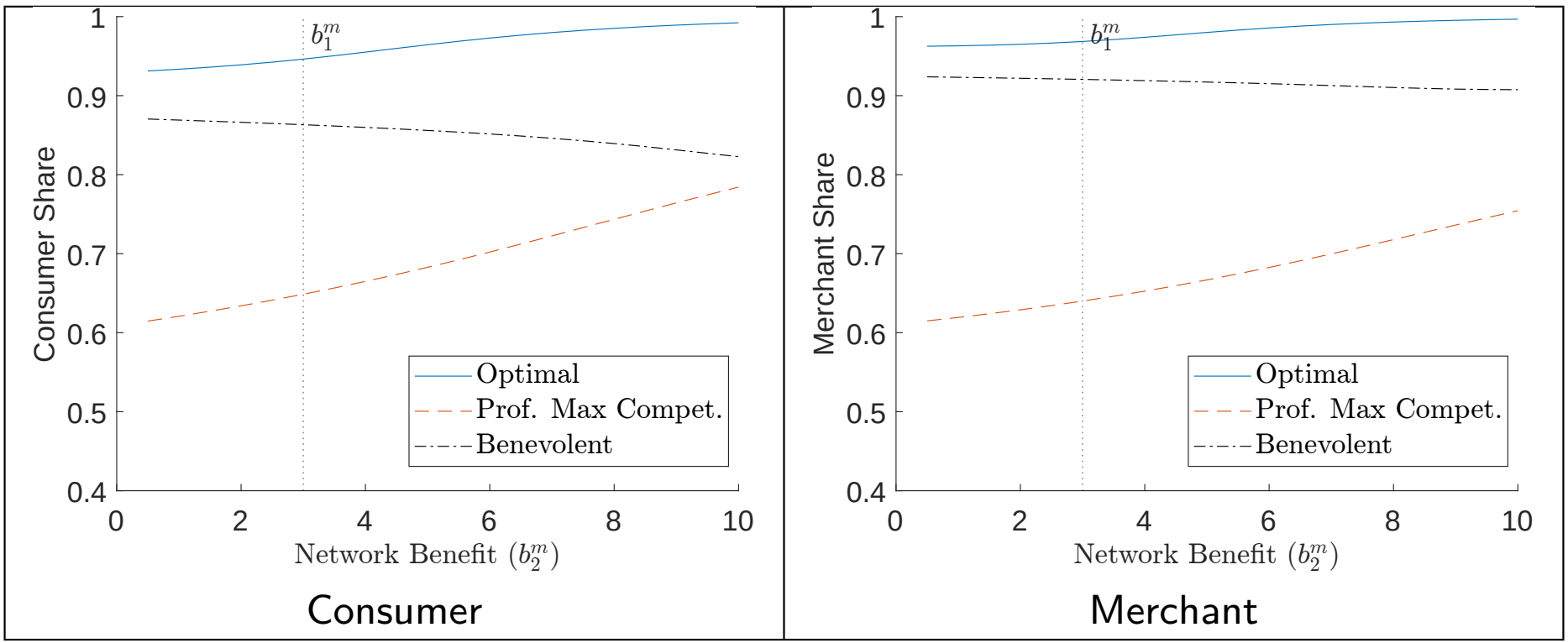
Impact on financial inclusion (changes with merchant network benefit)

CBDC improves the share of merchants/consumers using at least one platform

Share of users using any platform



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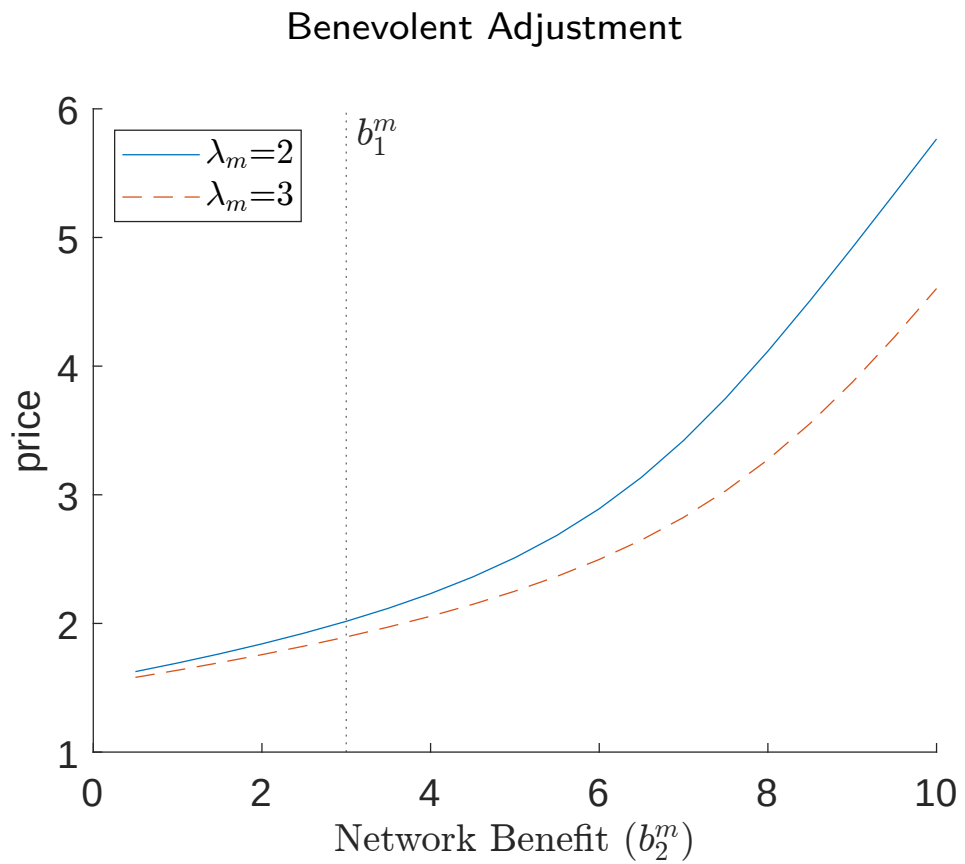

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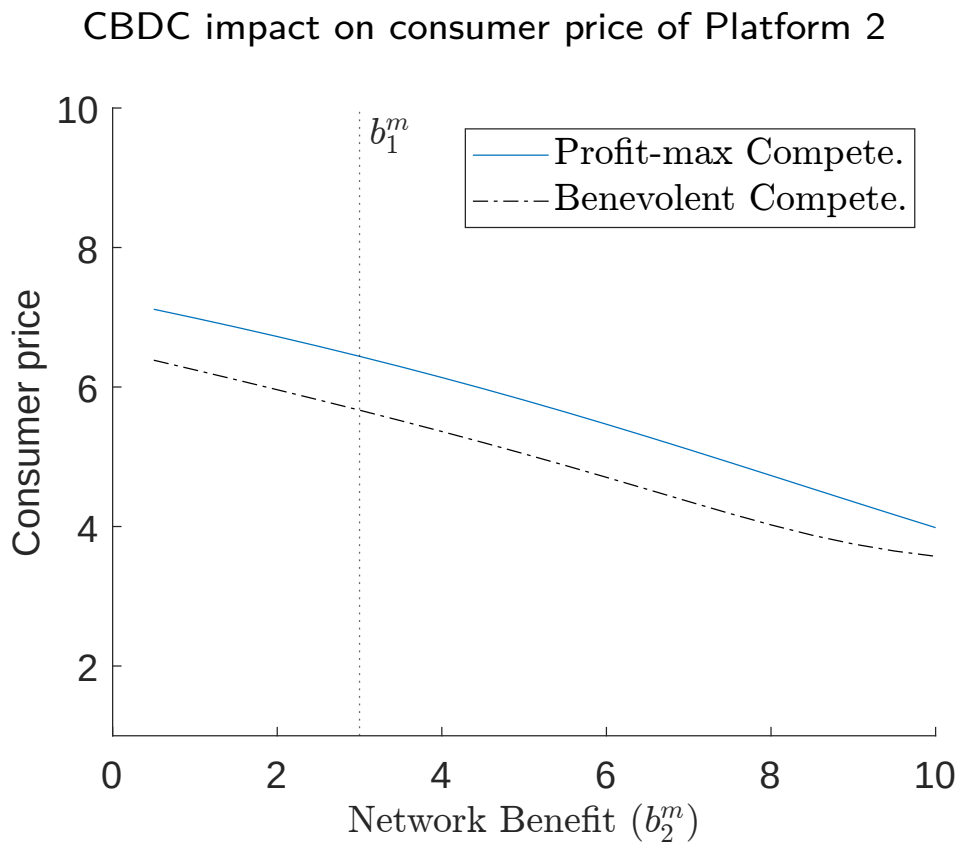
Impact on private platform prices (changes with merchant network benefit)

Platform 2 sets a lower consumer price facing a benevolent CBDC platform



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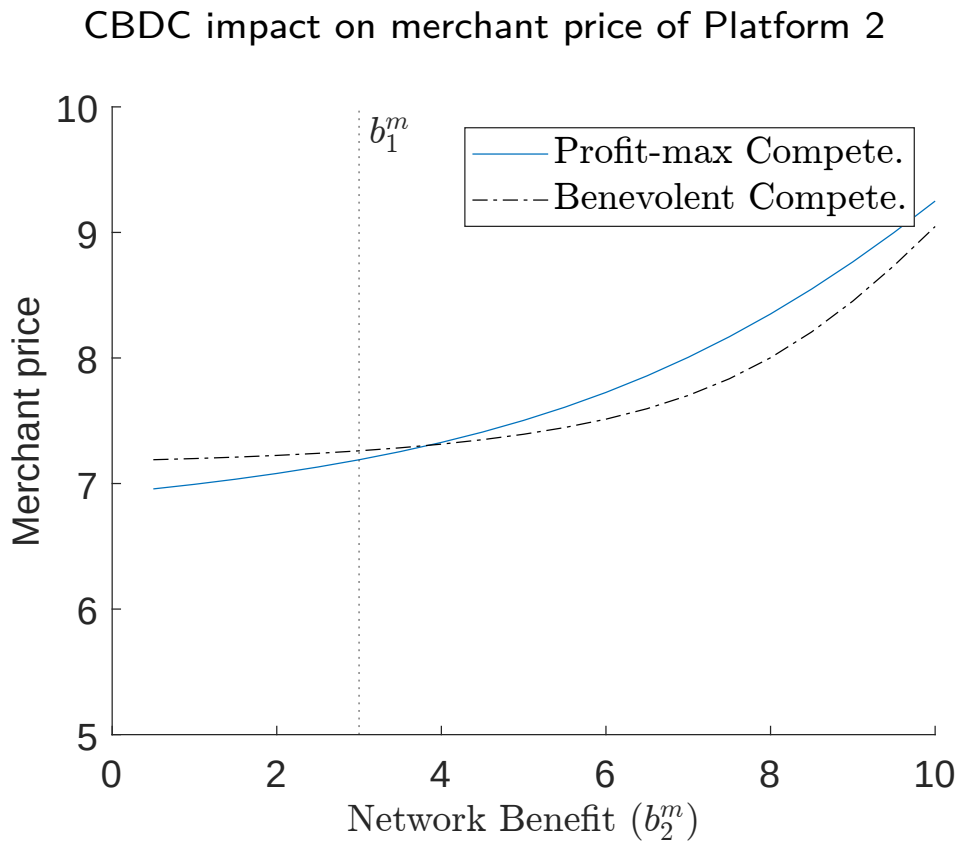
Impact on private platform prices (changes with merchant network benefit)

However, CBDC's impact on merchant price is uncertain because market power ↓ but scale distortion ↑



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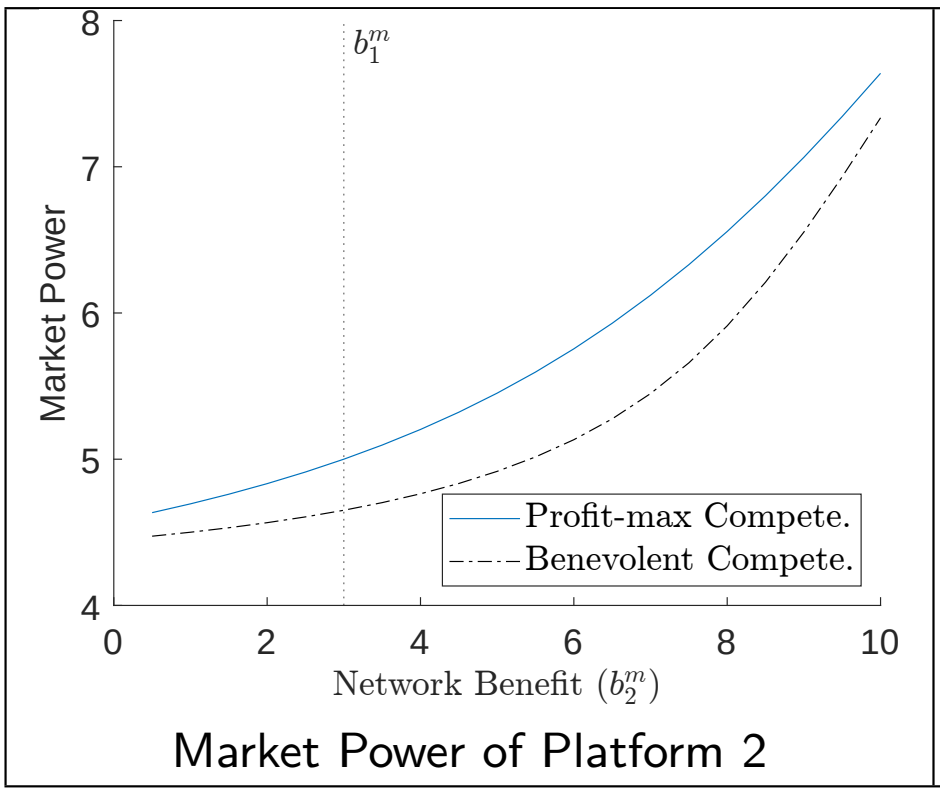
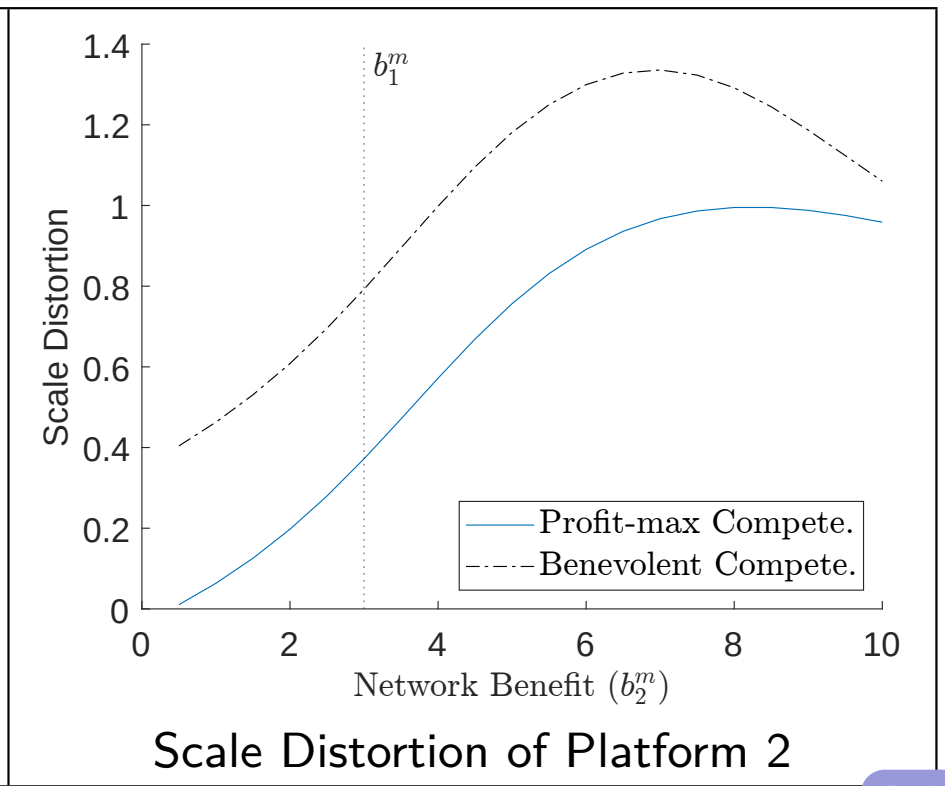
CBDC impact on merchant price distortions of Platform 2



Market Power of Platform 2



Scale Distortion of Platform 2

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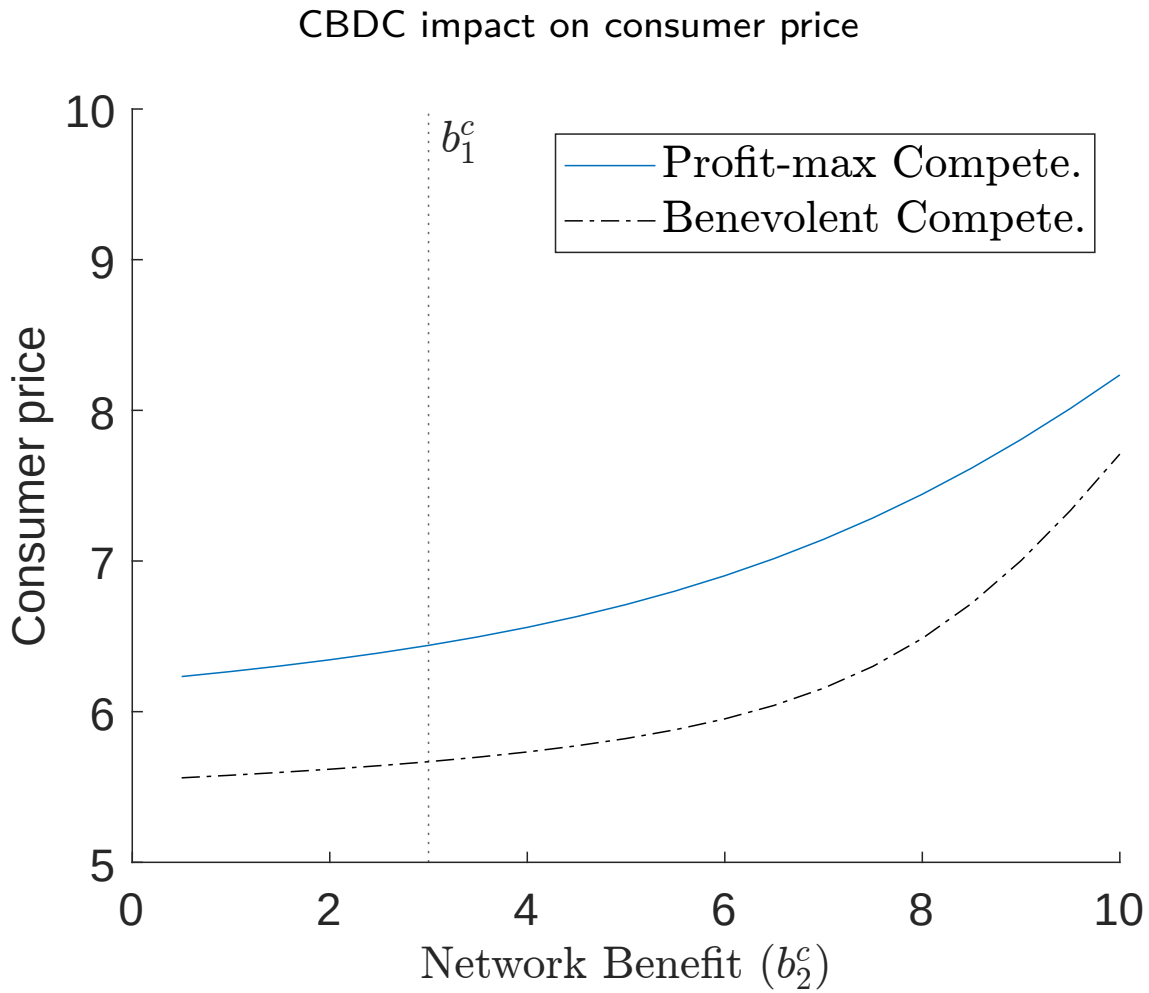

Change with merchant benefit

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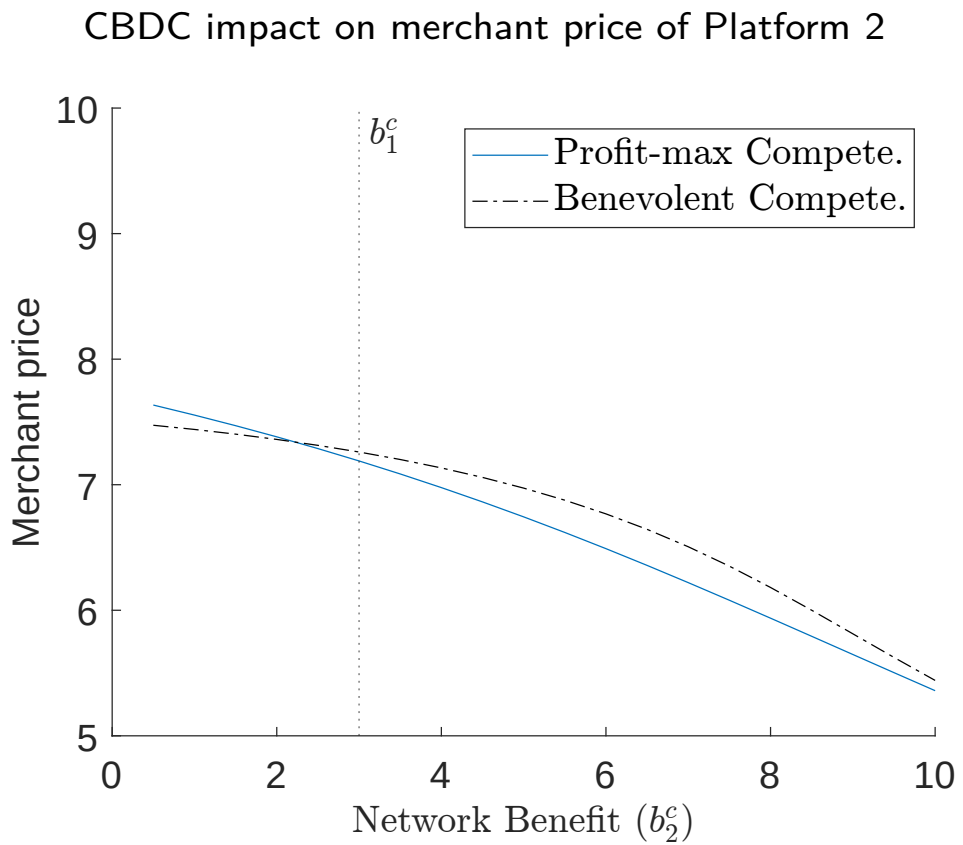

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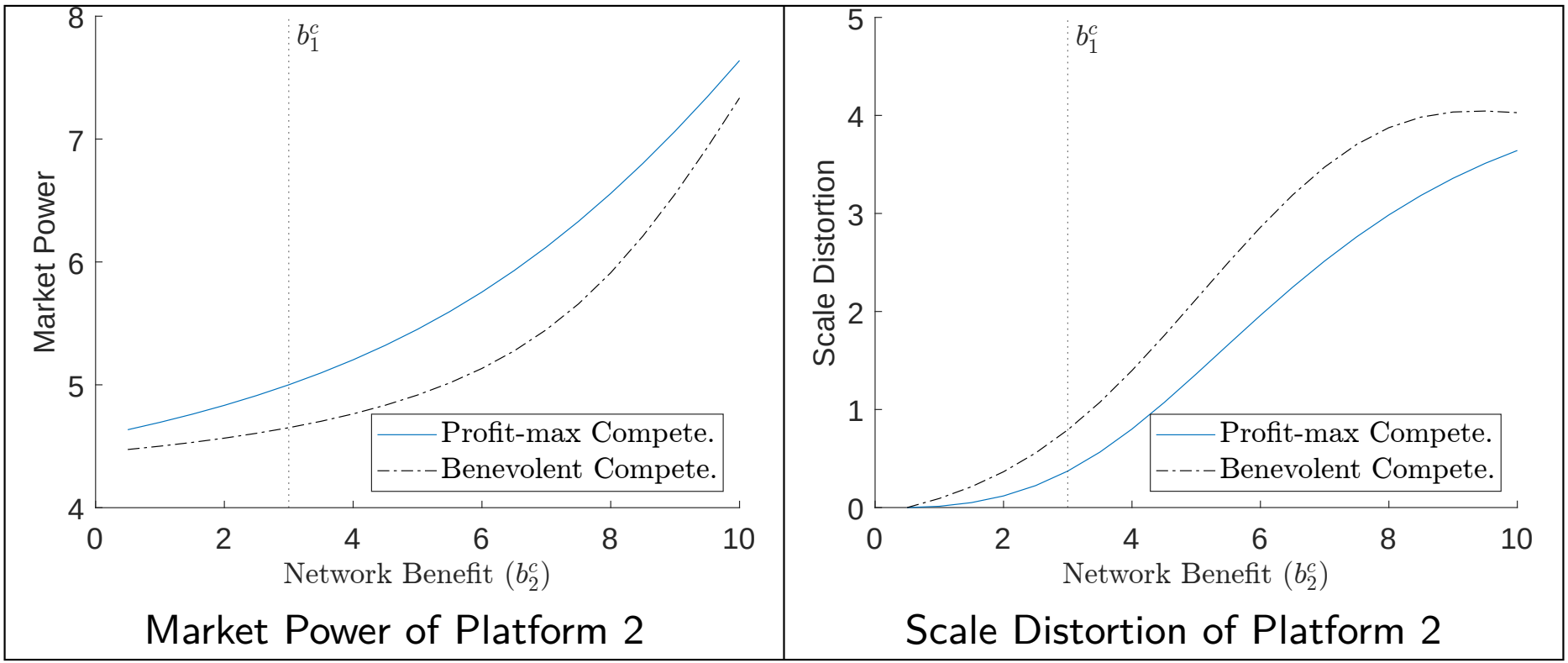
CBDC impact on merchant price distortions



Change with merchant benefit

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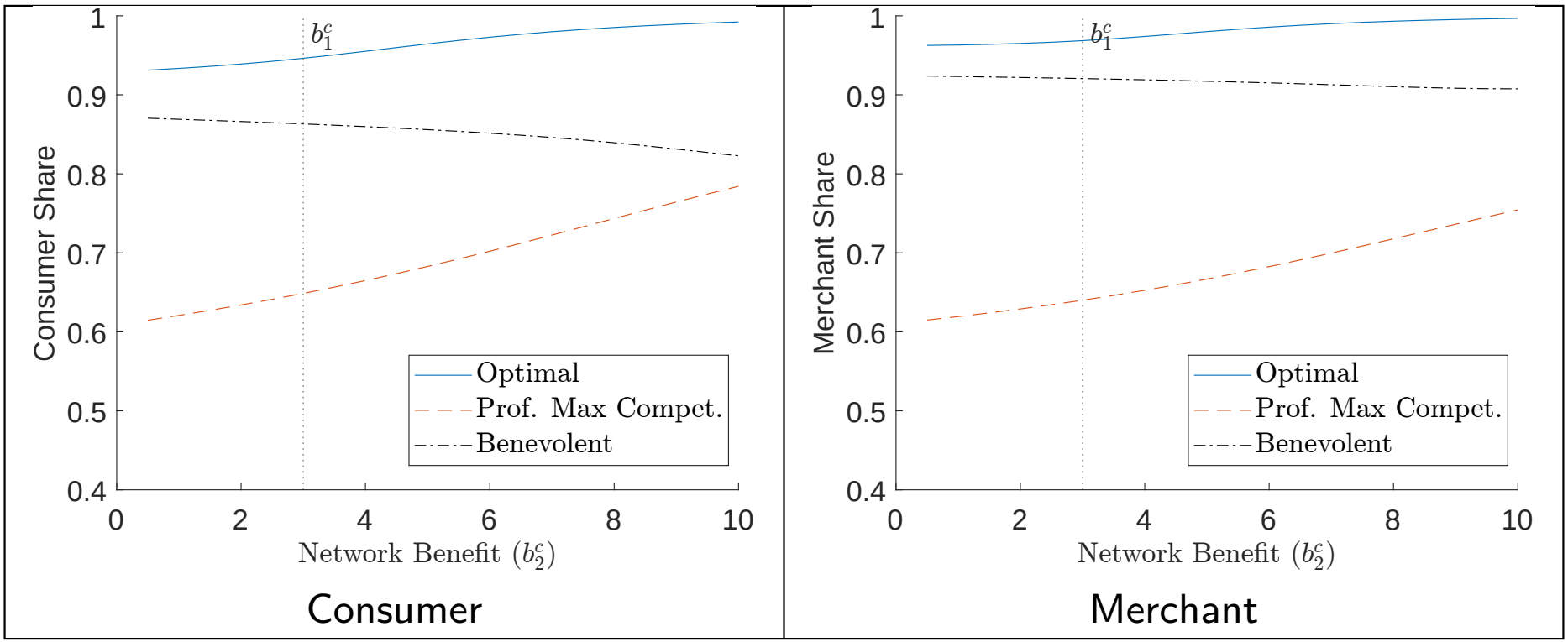

Change with merchant benefit

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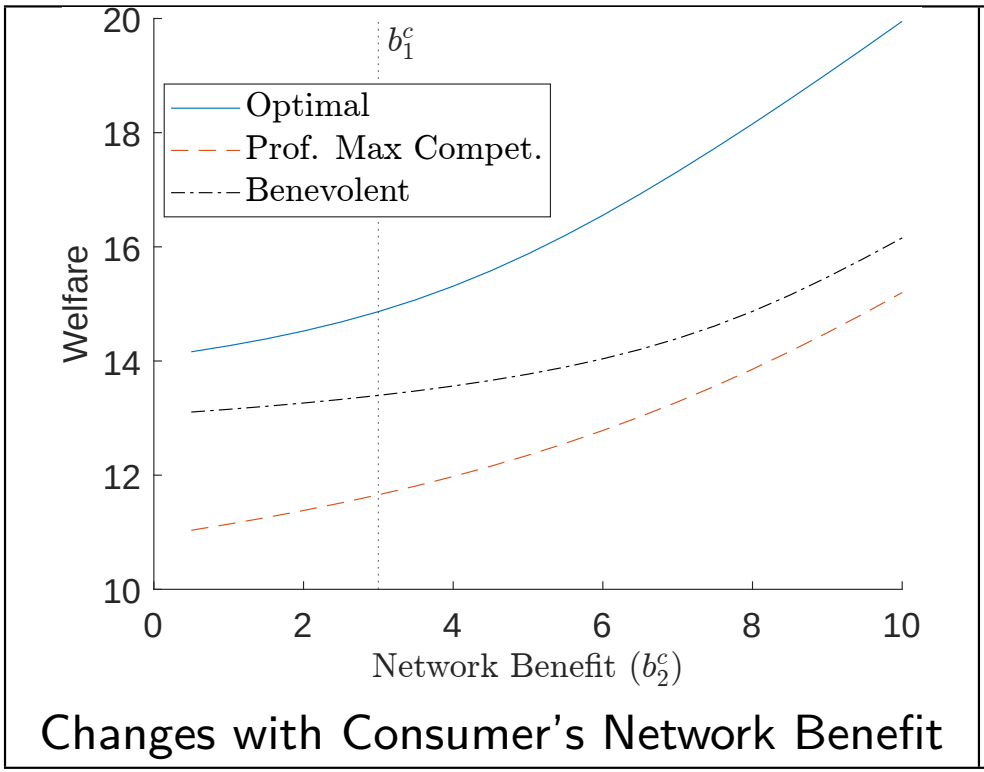
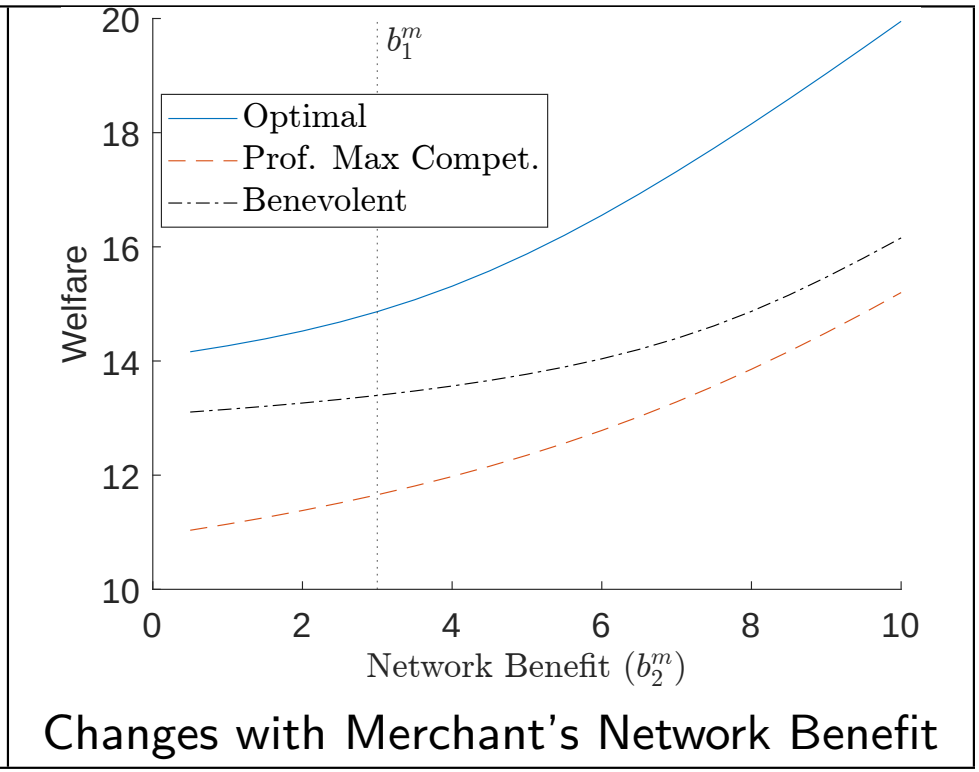
Impact on welfare

CBDC improves welfare even with relatively lower network benefits

CBDC impact on total welfare



Changes with Consumer's Network Benefit



Changes with Merchant's Network Benefit

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