Economic inequalities caused by Covid-19 and associated public health measures

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Motivation

- Work in Progress
- Covid-19 pandemic causes disruptions greater than any other event since World War II
- Disruptions
  - concern public health, the economy, mental well-being and many other things
  - are unequally distributed
- We focus on the economic impact of
  - changes in individual decisions and
  - public health measures

  in the light of an infectious disease such as Covid-19

Framework

- Equilibrium model with two sectors $j \in 1, 2$ for one period
- Firms produce sectoral output y_j
- Individuals
  - derive expected utility from consumption, different types of leisure and stochastic health
  - work in different sectors and receive labour income used for consumption
  - are immobile across sectors
  - are endowed with time and allocate it between various activities
- Some activities require leisure time only, some require leisure time and consumption
- Heterogenous infection risk q_j
- Public health measures can be issued by the government to reduce contact rates

Contribution and Findings

- Using a standard consumption and leisure approach (Brotherhood et al., 2020, Eichbaum et al. 2020a,b, Krueger et al. 2020), we explicitly distinguish infection risks for consumption and leisure activities
- We describe the impact of public health measures, regardless of their nature, for instance lockdowns (Acemoglu et al., 2020, Eichenbaum et al., 2020a,b, Krueger et al. 2020) or social distancing (Brotherhood et al., 2020, Fernandez-Villaverde and Jones, 2020), on individual and aggregate outcomes
- (Un)Ambiguity of health risk effects directly visible
- Wages are not pro-cyclical with sectoral output
- Positive labour supply shock when imposing public health measure on leisure activities

Model

- Firms
  - One factor of production: Labour
  - Output of sector j is described by a linear production function

$$y_j = a_j^h h_j \tag{1}$$

    where a_j^h describes productivity of workers in sector j and h_j hours of labour demanded in sector j
- Households
  - Instantaneous utility function reads

$$u_j = c_{1,j}^{\beta_1} c_{2,j}^{\beta_2} l_{2,j}^{\gamma_2} l_{3,j}^{\gamma_3} s^{-\delta} \tag{2}$$

  - Elasticities are strictly positive, heterogeneity with respect to sectors j, c indicates consumption activities, l indicates leisure activities, s utility from being healthy
  - Budget constraint

$$p_1 c_1 + p_2 c_2 = \underbrace{(\bar{l} - l_2 - l_3)}_{l_j^w} w_j \tag{3}$$

Model

- Health
  - Risk of infection affects utility through health level s
  - Probability of staying healthy q is described as

$$q_j = q_0 a_x c_1^{-\beta_1^q} c_2^{-\beta_2^q} l_2^{-\gamma_2^q} l_3^{-\gamma_3^q} (l_j^w)^{-\eta_j^q} \quad (4)$$

    where an infection comes from contacts $a_i^{c,l,w}$ according to contact rates $\alpha_i^{c,l,w}$ for certain activities, e.g. c, l, l_j^w
- Government issues various public health measures
  - Contact rules required inter alia face masks, social distancing or quarantines after travelling, which translates to setting α to a fixed value
  - Closures affected inter alia schools, kindergartens and other educational institutions, which translates to an exogenous time demand on total time endowment $\bar{l}$

Optimal Behaviour

- Households optimally choose consumption, leisure and working time such that

$$l_{k,j} = \Delta\gamma_k \Psi_j \bar{l} \quad (5)$$

$$l_j^w = (\Delta\beta_1 + \Delta\beta_2 + \eta_j^q)\Psi_j \bar{l} \quad (6)$$

$$c_{i,j} = \frac{\Delta\beta_i}{\Delta\beta_1 + \Delta\beta_2} \frac{w_j l_j^w}{p_i} \quad (7)$$

where

$$\Psi_j = \frac{1}{\Delta\beta_1 + \Delta\beta_2 + \Delta\gamma_2 + \Delta\gamma_3 - \eta_j^q}$$

$$\Delta\beta_i \equiv \beta_i - \beta_i^q \geq 0, \quad \Delta\gamma_k \equiv \gamma_k - \gamma_k^q \geq 0$$

Equilibrium

- Real wages in equilibrium

$$\frac{w_1}{p_1} = a_1^h \; ; \; \frac{w_2}{p_2} = a_2^h \tag{8}$$

$$\frac{w_1}{p_2} = a_2^h \frac{n_2}{n_1} \frac{\Delta\beta_1}{\Delta\beta_2} \; ; \; \frac{w_2}{p_1} = a_1^h \frac{n_1}{n_2} \frac{\Delta\beta_2}{\Delta\beta_1} \tag{9}$$

- Relative wages and prices are

$$\frac{w_2}{w_1} = \frac{n_1}{n_2} \frac{\Delta\beta_2}{\Delta\beta_1} \tag{10}$$

$$\frac{p_2}{p_1} = \frac{a_1^h n_1}{a_2^h n_2} \frac{\Delta\beta_2}{\Delta\beta_1} \tag{11}$$

- GDP reads

$$Y = y_1 + \frac{p_2}{p_1} y_2 \tag{12}$$

Results

- Optimal levels of leisure, labour supply and consumption depend on their respective difference in marginal utility and marginal risk Δ, time endowment $\bar{l}$ and health risk in general Ψ
- Excluding health risk, structure boils down to standard microeconomic results
- Surprisingly, infection risk when working η_j^q does not affect real wages, only infection risk in consumption does
- Relative output depends on all parameters that affect labour supply $y_1/y_2 \sim l_1^w/l_2^w$
- In terms of units of output, all sectors jointly expand/shrink whenever labour supply jointly expands/shrinks
- The empirically more relevant relative value added, p_1y_1/p_2y_2 changes as a function of health risks

Health risk

- So far: Health risk present, but constant
- For an increase in infection risk, considering for instance labour supply, we get

$$\frac{\partial l_j^w}{\partial \beta_j^q} = -\left(\Delta\gamma_2 + \Delta\gamma_3\right)\Psi_j^2 \bar{l} < 0,$$

$$\frac{\partial l_j^w}{\partial \gamma_k^q} = \left(\Delta\beta_1 + \Delta\beta_2 - \eta_j^q\right)\Psi_j^2 \bar{l} \gtrless 0, \quad \frac{\partial l_j^w}{\partial \eta_j^q} = -\left(\Delta\gamma_2 + \Delta\gamma_3\right)\Psi_j^2 \bar{l} < 0$$

- Direct effect vs. indirect effect
- If infection risk via consumption (β_j^q) or via work (η_j^q) increases, the effect on labour supply is negative
- If infection risk via leisure (γ_k^q) increases, the effect on labour supply becomes ambiguous and depends on consumption (β_j^q) and working infection risk (η_j^q)

Limiting a leisure activity

- Different ways to limit a leisure activity, e.g.
  - Social distancing
  - Restricting certain activities
  - Closing venues
- In model terms, a limit is put on one activity's contact rate
- Considering for instance leisure activity 2

$$l_2 \leq l_2^{\text{auth}} \equiv \frac{a_2^{l,auth}}{\alpha_2^l} \tag{13}$$

- Restriction is binding
- We find that
  - individuals optimally shift resources
  - When leisure is restricted (most common), time is reallocated to other leisure activities and labour supply
  - The latter translates into rising consumption

Shutting down schools and kindergartens

- As outlined above, such measures represent an exogenous time demand on overall time endowment $\bar{l}$
- This translates to
  - Leisure time of any activity is reduced by l^{exo}
  - Working time reduces similarly
  - $\Rightarrow$ Without compensation, income as well as consumption decrease
- Overall, individuals affected by this public health measure are worse-off than those not affected
- Subsequently this effects equilibrium outcomes

Conclusion

- Canonical consumption-leisure approach, where risk of infection differs between activities
- We captured changes in health risk and their implications on individual and equilibrium outcomes
- If health risk of an activity rises, individuals optimally reduce the corresponding activity
- Effect on other activities, however, can become ambiguous
- If a public health measure is introduced, resources are optimally reallocated
- Exogenous time demands for a certain group of individuals caused through public health measures affect these individuals negatively
- Still a lot of work to do - Thank you very much for your attention