Keynesian Micromanagement

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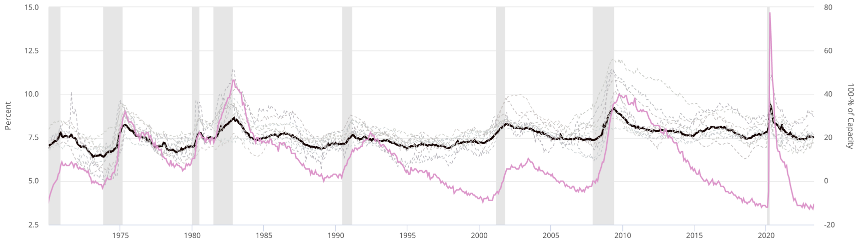
Slack in the US economy



This paper

- The aim of the paper is twofold: build a framework to analyse **granular** spare capacity and characterise optimal **granular** government spending policy
- Build a novel general equilibrium **multi-sector model** with **goods market search frictions** at the level of sectoral varieties
  - Households and the Government search for goods as final customers, Firms search for goods as intermediate customers
  - The model generates sector-specific **involuntary spare capacity**, which is, in general, inefficient and can be corrected with **sector-specific demand management** using government consumption
  - One of the sectors is a **labor union**, whose spare capacity represents **involuntary unemployment**
- Relative to the frictionless benchmark, government spending can generate **endogenous productivity** fluctuations:

Utilisation Effect *vs.* Congestion Effect

- Extra government spending on a sector can either increase or decrease endogenous sectoral productivity, depending on which of the two effects dominates

Optimal sector-specific government spending policy

- Consider a household who consumes N goods (cars, food, computers etc), and each good i can be either privately purchased (C_i) or provided by the government (G_i), amounting to utility:

$$\mathcal{U}(C_1, ..., C_N; G_1, ..., G_N)$$

- Optimal government provision of good i satisfies:

$$\underbrace{MRS_i^{GC} = 1}_{\text{Samuelson rule}} - \frac{1}{\omega_i^G} \frac{d \log TFP}{d \log G_i}, \quad \forall i$$

where

- $MRS_i^{GC} \equiv \frac{\partial \mathcal{U} / \partial G_i}{\partial \mathcal{U} / \partial C_i}$ is marginal rate of substitution between public and private provision of good i
- ω_i^g is nominal government spending on good i as a share of nominal GDP
- TFP is aggregate measure total factor productivity

- The first-order effect of G_i on aggregate TFP can be obtained by canonical Hulten (1978) aggregation:

$$\frac{d \log TFP}{d \log G_i} = \sum_j \lambda_j \frac{\partial \log A_j}{\partial \log G_i}$$

where λ_j is the Domar weight (sales share) of sector j

MULTI-SECTOR MODEL WITH SEARCH FOR GOODS

Multi-sector model with search: an overview

- Agents: firms subdivided into $N+1$ sectors, indexed by $\{0, 1, ..., N\}$, households, fiscal authority

- Market for each sectoral good is subject to a search friction, summarized by a CRS matching function:

$$Y_i = h^i(K_i, V_i), \quad \forall i$$

where y_i is sales, K_i is productive capacity and V_i is the total number of visits:

$$V_i = V_i^H + V_i^G + V_i^F, \quad \forall i$$

- Sectoral goods market tightness x_i is defined as:

$$x_i \equiv \frac{V_i}{K_i}, \quad \forall i$$

- Probabilities of a successful sale $f_i(x_i)$ and a successful visit $q_i(x_i)$:

$$f_i(x_i) \equiv Y_i/K_i, \quad f' > 0 \qquad q_i(x_i) \equiv V_i/K_i, \quad q' < 0, \quad \forall i$$

- Each visit costs ρ_i of the sectoral good; hence consuming one unit requires purchasing:

$$1 + \gamma_i(x_i), \quad \gamma_i' > 0, \quad \forall i$$

units, where $1 + \gamma_i(x_i) \equiv q_i(x_i)/(q_i(x_i) - \rho_i)$ is the sectoral **congestion wedge**

Firms

- Firms in sector i produce endogenous capacity K_i using the following CRS technology:

$$K_i = F_i(L_i, \{Z_{ij}\}_{j=1}^N), \quad \forall i$$

where L_i is labor input, Z_{ij} is intermediates purchased by sector i from sector j

- Cost minimization:

$$\min_{L_i, \{Z_{ij}\}_{j=1}^N} [WL_i + \sum_j \underbrace{P_j[1 + \gamma_j(x_j)]}_{\text{Effective price}} Z_{ij}]$$

subject to the production function $F_i(.)$

- Delivers CRS marginal cost function $MC_i(W, \{P_j[1 + \gamma_j(x_j)]\}_{j=1}^N)$

- Define sectoral rate of **spare capacity** s_i as

$$S_i \equiv 1 - f_i(x_i), \quad \forall i$$

- Zero profit condition:

$$P_i \underbrace{(1 - S_i)K_i}_{\text{Total sales}} = \underbrace{MC_i K_i}_{\text{Total costs}}$$

Households and Government

- Each sectoral good consumed by households can either be purchased privately (C_i) or provided publicly (G_i); final demand for a variety obtained using a CRS aggregator:

$$D_i(C_i, G_i), \quad \forall i$$

- Households choose private consumptions of sectoral varieties and the numeraire good (traded frictionlessly, fixed supply $\overline{M}$) to maximise utility:

$$\max_{\{C_i\}_{i=1}^N, M} [\mathcal{U}(D_1, ..., D_N) + \mathcal{V}(M)]$$

subject to the final demand aggregators $\{D_i(.)\}_{i=1}^N$ and the budget constraint:

$$\sum_i \underbrace{P_i[1 + \gamma_i(x_i)]}_{\text{Effective price}} C_i + M \leq W\overline{L} + \overline{M} + \sum_i \Pi_i - T$$

- Given public demands $\{G\}_{i=1}^N$, the government levies a lump-sum tax to finance its expenditure:

$$T = \sum_i \underbrace{P_i[1 + \gamma_i(x_i)]}_{\text{Effective price}} G_i$$

Equilibrium

- Given public demands $\{G_i\}_{i=1}^N$, the optimality conditions express all the choice variables as functions of sectoral prices and tightnesses $\{P_i, x_i\}_{i=1}^N$

- Close the model with labor market clearing ($\sum_i L_i = \overline{L}$), as well as in the goods market:

$$C_i + G_i + \sum_{j=1}^{N} Z_{ji} = \frac{\overbrace{1 - s_i(x_i)}^{\text{Utilisation wedge}}}{\underbrace{1 + \gamma_i(x_i)}_{\text{Congestion wedge}}} K_i, \quad \forall i$$

- Let $\mathcal{A}_i(x_i) \equiv \frac{1-s_i(x_i)}{1+\gamma_i(x_i)}$, then there exists x_i^* such that $\mathcal{A}_i'(x_i^*) = 0$, and $\mathcal{A}_i'(x_i) >< 0$ for $x_i <> x_i^*$

- Moreover, x_i^* is the (constrained) efficient level of tightness in each sector

- Need to specify a pricing rule to separately pin down movements in tightness:

$$P_i = \mathcal{P}_i(MC_i), \quad \forall i$$

where $\mathcal{P}_i' \geq 0, \quad \mathcal{P}_i'' \leq 0, \quad \forall i$

OPTIMAL FISCAL POLICY

Optimal Fiscal Policy

- Equilibrium outcomes are conditional on a specific set of government consumptions $\mathbb{G} \equiv \{G_i\}_{i=1}^N$

- Formally, optimal fiscal policy problem can be written as:

$$\max_{\{G_i\}_{i=1}^N} \mathcal{U}\left[D^1\left(C_1(\mathbb{G}), G_1\right), ..., D^N\left(C_N(\mathbb{G}), G_N\right)\right]$$

- Sectoral government spending affects utility through two channels: direct and indirect

- Indirect effect: government spending in any sector k (G_k), in general, affects private consumption in any other sector i (C_i):

$$\frac{\partial C_i(\mathbb{G})}{\partial G_k} = \overbrace{A_i'(x_i)\frac{\partial x_i(\mathbb{G})}{\partial G_k}K_i + A_i(x_i)\frac{\partial K_i(\mathbb{G})}{\partial G_k}}^{\text{Supply-side effect}} - \overbrace{\frac{\partial G_i}{\partial G_k} - \sum_{j=1}^{K}\frac{\partial Z_{ji}(\mathbb{G})}{\partial G_k}}^{\text{Demand-side effect}}$$

Optimal Fiscal Policy

Proposition

First order condition for optimal government consumption of sector i's output (G_i) is given by:

$$\text{FOC}(G_i): \qquad \omega_i^G[1 - MRS_i^{GC}] = \sum_{t=0}^{N} \lambda_t \frac{d\log A_t(x_t)}{d\log x_t} \frac{\partial \log x_t}{\partial \log G_i}, \qquad i = 1, ..., N$$

where

- $MRS_i^{GC} \equiv \frac{\partial D_i / \partial G_i}{\partial D_i / \partial C_i}$ *is the marginal rate of substitution between government and households' consumption of sector i's output*
- $\omega_i^G \equiv \frac{P_i[1+\gamma_i(x_i)]G_i}{\sum_{j=1}^N P_j[1+\gamma_j(x_j)](C_j+G_j)}$ *is nominal government expenditure on sector i as a share of nominal GDP*
- $\lambda_i \equiv \frac{P_i[1+\gamma_i(x_i)]A_i(x_i)K_i}{\sum_{j=1}^N P_j[1+\gamma_j(x_j)](C_j+G_j)}$ *is the Domar weight (sales share) of sector i*

- Can view the aggregate supply-side effect of fiscal policy through Hulten's (1978) theorem:

$$d\log TFP = \sum_{j=0}^{N} \lambda_j d\log A_j(x_j)$$

where λ_j is the Domar weight (sales share) of sector j

Optimal Fiscal Policy

Theorem

Optimal government consumption of sector i's output (G_i) *satisfies:*

$$\underbrace{MRS_i^{GC}}_{\text{Samuelson rule}} = 1 - \frac{1}{\omega_i^G} \times \frac{d \log TFP}{d \log G_i}, \qquad i = 1, \ldots, N$$

where

- MRS_i^{GC} *is the marginal rate of substitution between government and households' consumption of sector i's output*
- ω_i^G *is nominal government expenditure on sector i as a share of nominal GDP*
- *TFP is aggregate measured total factor productivity.*

- If already at constrained efficiency $(x_i = x_i^*, \forall i) \Longrightarrow \mathcal{A}_i'(x_i) = 0 \Longrightarrow MRS_i^{gc} = 1, \forall i$
- If private and public versions of the same good are perfect substitutes $\Longrightarrow$ Optimal fiscal policy achieves $(x_i = x_i^*, \forall i)$
- Generalisable to settings with endogenous labor supply, segmented labor markets

Optimal Fiscal Policy: an Approximation

Functional Forms

- Assume CES aggregators for final demands:

$$D^i(C_i, G_i) = \left[(1-\delta_i)^{\frac{1}{\epsilon_i}} C_i^{\frac{\epsilon_i - 1}{\epsilon_i}} + \delta_i^{\frac{1}{\epsilon_i}} G_i^{\frac{\epsilon_i - 1}{\epsilon_i}}\right]^{\frac{\epsilon_i}{\epsilon_i - 1}}, \quad \forall i$$

- Assume the following utility function:

$$\mathcal{U} = \sum_{i=1}^{N} \frac{[D^i(C_i, G_i)]^{1-\sigma} - 1}{1-\sigma}$$

where $\sigma > 0$

- Assume a Cobb-Douglas matching function:

$$h^i(K_i, V_i) = K_i^{\eta_i} V_i^{1-\eta_i}, \quad \forall i$$

- Assume constant pass-through of marginal costs to prices:

$$\mathcal{P}_i(MC_i) = MC_i^{1-r_i}, \quad \forall i$$

Optimal Fiscal Policy: an Approximation

- Recall the FOC for sectoral public consumption:

$$\text{FOC}(G_i): \qquad \omega_i^g \left[1 - MRS_i^{GC}\right] = \sum_{t=0}^{N} \lambda_t \frac{d \log A_t}{d \log x_t} \frac{\partial \log x_t}{\partial \log G_i}, \quad \forall i \qquad .$$

- Each term can be expressed as a function of $[\{x_i\}_{i=0}^N, \{(G_i/Ci)\}_{i=1}^N]$

- Moreover, given the mapping between tightness and spare capacity ($s = 1 - f(x)$), can express as a function of $\left[\{S_i\}_{i=0}^N, \{(G_i/Ci)\}_{i=1}^N\right]$

- Today: consider first-order approximations around $\left[\{S_i^*\}_{i=0}^N, \{(G_i/Ci)^*\}_{i=1}^N\right]$, where $S_i^* = 1 - f(x_i^*), \forall i$ and $MRS_i^{GC}(G_i/Ci)^* = 1, \forall i$

Optimal Fiscal Policy: an Approximation

Proposition (Optimal policy near constrained efficiency)

Around constrained efficiency, optimal deviations of sectoral government consumptions and sectoral spare capacities satisfy:

$$\hat{gc}_i = \frac{\zeta_i}{1-\delta_i} \times \underbrace{\left[\sum_{t=0}^{N} \lambda_t^* \frac{r_t}{1-\eta_t} \hat{s}_t\right]}_{\text{Common component}}$$

where

$$\zeta_i \equiv \frac{\left(\frac{\delta_i}{1-\delta_i}\frac{1}{\epsilon_i} + \sigma\right)^{-1}}{\sum_{j=1}^{N} \omega_j^{CG} \left(\frac{\delta_j}{1-\delta_j}\frac{1}{\epsilon_j} + \sigma\right)^{-1}}$$

and $\hat{gc}_i \equiv [\log(G_i/C_i) - \log(G_i/C_i)^*]$, $\hat{s}_t \equiv (S_t - S_t^*)/(1-S_t^*)$.

- Sectoral component: dependence on the elasticity of substitution between private and public provision
- Common component: larger weight on spare capacity of sectors that are: (i) larger (λ_t); (ii) have lower price-cost pass-through (r_i); (iii) lower elasticity of spare capacity to tightness (η_t)

Current work

1. Study optimal fiscal policy away from (constrained) efficiency:
   - Changes in Domar weights and tightness cross-multipliers become first order – policy no longer network irrelevant!
2. Study the role of labor market segmentation and endogenous labor supply
3. Fiscal policy without lump-sum taxes: distortionary taxation and spending rebalancing across sectors
4. Use the formulas to assess the normative properties of stimulus programs in response to the Great Recession and the Covid-19 pandemic

Conclusion

- Develop a novel theory of optimal sector-specific government spending
- Study optimal policy in the context of a novel multi-sector model with goods market search
- Theoretical results provide a tractable generalisation of the classic Samuelson principle
- Current work on extending existing results

APPENDIX