Taxpayer Status and Monopoly Markup in Vertical Industrial Structure

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Outline

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2. Model Setup
   - Upstream Enterprises
   - Downstream Enterprises
   - The Final Goods consumption
   - The Sector of Productive Factors
   - Equilibrium Conditions
3. Temporary Findings
4. Future work

Motivation

Economics question: How the threshold for taxpayer status make VAT non-neutral and lead to distortion?

- Most countries with a Value Added Tax follow the ”European model”, whose key features are a consumption base, tax credits based on invoices, and a destination principle. (Agha and Haughton, 1996)
- The reality is that many companies do not have the qualification to issue invoices.
- One of the main factors that deviates from the ideal optimal VAT is the taxpayer status.

Model Approach

- To describe the interruption of the invoice chain, we need to build a vertical industrial chain. (Hsieh and Klenow, 2009; Li et al., 2024)
- We need to derive profit differences and pricing strategies under different taxpayer identities.(Paula and Scheinkman, 2010; Waseem, 2022, 2023)
- Both upstream and downstream enterprises should have certain market power, that is, engage in monopolistic competition. (Baqaee, 2024; Pless and Van Benthem, 2010)

Taxpayer identity in reality

表 1　　增值税一般纳税人与小规模纳税人管理的主要制度性文件

序号	名称	发文字号	主要规定	实施日期	截止日期
1	《国家税务总局关于明确二手车经销等若干增值税征管问题的公告》	国家税务总局公告2020年第9号	一般纳税人可转小规模纳税人	2020. 4. 23	2020. 12. 31
2	《国家税务总局关于小规模纳税人免征增值税政策有关征管问题的公告》	国家税务总局公告2019年第4号	一般纳税人可转小规模纳税人	2019. 1. 1	2019. 12. 31
3	《关于统一小规模纳税人标准等若干增值税问题的公告》	国家税务总局公告2018年第18号	一般纳税人可转小规模纳税人	2018. 5. 1	2018. 12. 31
4	《中华人民共和国增值税暂行条例实施细则》(2011年修订)	中华人民共和国财政部令第65号	仅小规模纳税人转一般纳税人	2009. 1. 1	
5	《中华人民共和国增值税暂行条例实施细则》	财法字〔1993〕38号	仅小规模纳税人转一般纳税人	1994. 1. 1	

图: 赵 颖等: 纳税人身份选择与就业机会 2023

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Taxpayer status

Based on the total sales revenue $\sum p_i Y_i$, the size of the enterprise can be determined like

$$\begin{cases} pY_i \geq \kappa_1 & \text{General taxplayers} \\ pY_i < \kappa_1 & \text{Small-scale taxpayers} \end{cases}$$

We assume that the value-added tax rate for general taxpayers in the model is τ, and the tax rate (also called levy rates) for small-scale taxpayers is t. Normally, the $\tau > t$ holds for most of VAT rules.

We also assume that the productivity endowment θ_i^U $(\theta_j^D))$ of each upstream (downstream) firm i (j) follows a log-normal distribution. Formally, we define:

$$\theta_i^U \sim \text{Log-Normal}(\mu, \sigma^2), \tag{1}$$

where μ and σ^2 are the mean and variance of the underlying normal distribution, respectively.

Upstream Enterprises

Consider a total of n upstream enterprises, with each enterprise i having unique productivity endowments θ_i^U, purchasing capital K_i and labour L_i from the labour dispatch department. The companies produce intermediate products based on Cobb-Douglas function as:

$$F_i(L, K) = A(\theta_i^U) L_i^{\gamma} K_i^{1-\gamma} \tag{2}$$

where $A(\cdot)$ represents the Total Factor Productivity(TFP) of company i and it is related to the unique endowments.

Intermediate product d_i, $d_i = \{d_1,\ d_2\ \cdots\ d_n\}$.
For upstream enterprises i, we can sign its production quantity as:

$$D_i = \sum d_i \tag{3}$$

General taxpayer

The objective function of maximizing profits for general taxpayer i is:

$$\max_{K,L} \Pi_i = (1-\tau)\, p_i^G A(\theta_i^U) L_i^{\gamma} K_i^{1-\gamma} - \omega L_i - r K_i \tag{4}$$

where p_i^G is the sale price of intermediate product for general enterprise i depending on the downstream consumption, ω and r represent the price of labour and capital including the value-added tax, respectively.

Small-scale taxpayer

Small-scale taxpayers may collude with labour dispatch departments to conceal this part of the transaction.The function of maximizing profits for them is:

$$\max_{K,L} \Pi_i = (1-t)\, p_i^S A(\theta_i^U) L_i^{\gamma} K_i^{1-\gamma} - \frac{1}{1+\tau}\omega L_i - \frac{1}{1+\tau} r K_i \tag{5}$$

where p_i^S is the sale price of intermediate product for small-scale firms i and $\frac{1}{1+\tau}$ is the coefficient converted to the price excluding tax and$t$ represents the levy rate for small-scale taxpayers.

Downstream Enterprises

- Consider a total of m downstream enterprises, with each enterprise j having unique endowments θ_j^D, purchasing capital K_j and labour L_j from the labour dispatch department and the aggregation intermediate goods D_j^*.
- Purchasing intermediate goods perform a CES aggregation on the products d_i from 1 to n.

$$D_j^* = F(d_1,\ d_2\ ...\ d_n) = \left(\sum_{i=1}^{n} \phi_j^0 (d_{ij})^{\rho_0} \right)^{\frac{1}{\rho_0}} \tag{6}$$

where D_j^* represents the aggregated intermediate good for enterprise j, d_{ij} means that enterprise j requires a specific quantity of product d_i

Downstream Enterprises

For downstream enterprise j, producing the final product is also based on Cobb-Douglas function.

$$F_j(L, K, D^*(d)) = A\left(\theta_j^D\right) L_j^\alpha K_j^\beta \left(D_j^*\right)^{1-\alpha-\beta} \tag{7}$$

$$= A\left(\theta_j^D\right) L_j^\alpha K_j^\beta \left(\left(\sum_{i=1}^{n} \phi_j^0 \left(d_{ij}\right)^{\rho_0}\right)^{\frac{1}{\rho_0}}\right)^{1-\alpha-\beta} \tag{8}$$

where $A(\cdot)$ represents the TFP of enterprise j and it is related to the unique endowments. Similarly, we assume that $\alpha + \beta < 1$.

Final products: $c_j = \{c_1,\ c_2\ \cdots\ c_m\}$

General taxpayer

The objective function of maximizing profits for general taxpayer j in downstream is:

$$\begin{aligned}\max_{K,L,D} \Pi_j &= (1-\tau)\, p_j^G A\left(\theta_j^D\right) L_j^{\alpha} K_j^{\beta} \left(\left(\sum_{i=1}^{n} \phi_j^0 \left(d_{ij}\right)^{\rho_0}\right)^{\frac{1}{\rho_0}}\right)^{1-\alpha-\beta} \\ &\quad - \left(\omega L_j + r K_j\right) - \sum_i p_i d_{ij}\end{aligned} \tag{9}$$

where p_j^G represents the sales price of final good produced by general enterprise j.

Small-scale taxpayer

They still can bargain to conceal the transaction, therefore, their objective function is:

$$\begin{aligned}\max_{L,K,D} \Pi_j &= (1-t)\, p_j^S A \left(\theta_j^D\right) L_j^{\alpha} K_j^{\beta} \left(\left(\sum_{i=1}^{n} \phi_j^0 \left(d_{ij}\right)^{\rho_0} \right)^{\frac{1}{\rho_0}} \right)^{1-\alpha-\beta} \\ &- \left(\frac{1}{1+\tau}\omega L_j + \frac{1}{1+\tau} r K_j\right) - \sum_i p_i d_{ij}\end{aligned} \tag{10}$$

where p_j^S represents the sales price of final good produced by small-scale firm j, while the meanings of other parameters are consistent with those defined earlier in the text.

Representative consumer

For the representative consumer h, his income is composed of labor provision and capital returns, and he derive utility by purchasing final goods from downstream firms. The consumption function adheres to the Constant Elasticity of Substitution (CES) form, given by:

$$\max U_h(c_1, c_2, \ldots, c_m) = \left(\sum_{j=1}^{m} \phi_j^c c_j^{\rho_c} \right)^{\frac{1}{\rho_c}} \tag{11}$$

$$s.t. \quad I = \sum_j p_j c_{jh} = \left(\frac{1}{1+\tau}\omega L + \frac{1}{1+\tau} rK\right) \tag{12}$$

The Sector of Productive Factors

- Labor (L) and capital (K) are supplied by households and specialised factor providers (e.g., labour dispatch agencies).
- These factors are purchased by upstream and downstream enterprises for production.
- Households supply labour inelastically at wage rate ω. Labour dispatch agencies act as intermediaries, charging a markup proportional to the VAT rate τ. For general taxpayers, the effective labour cost is ωL, while small-scale taxpayers face a reduced cost $\dfrac{\omega L}{1+\tau}$ due to tax evasion incentives.
- Capital is supplied at rental rate r. Similar to labour, general taxpayers incur rK, whereas small-scale taxpayers pay $\dfrac{rK}{1+\tau}$. The capital supply is assumed fixed in the short run but adjusts dynamically with investment in the long run.

Equilibrium Conditions–factors

The equilibrium prices of labor and capital are determined by market clearing conditions:

$$\sum_{i=1}^{n} L_i^U + \sum_{k=1}^{m} L_k^D = L_{\text{total}} \tag{13}$$

$$\sum_{i=1}^{n} K_i^U + \sum_{k=1}^{m} K_k^D = K_{\text{total}} \tag{14}$$

where L_i^U, K_i^U denote labor and capital used by upstream firm i, and L_k^D, K_k^D denote downstream firm k's usage.

Equilibrium Conditions–products

The enterprises in upstream and downstream markets are both taking monopolistic competition. For intermediate products, the market cleaning condition is:

$$F_i = A(\theta_i^U) L_i^\alpha K_i^\beta = \sum_{j=1}^{m} d_{ij}, \quad \forall i = 1, ..., n \tag{15}$$

The final goods face the condition as:

$$F_j = A(\theta_j^D) L_j^\alpha K_j^\beta (D_j^*)^{1-\alpha-\beta} = \sum_{h} c_{jh}, \quad \forall j = 1, ..., m \tag{16}$$

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The key solution

The solution follows the principle of backward induction.
The demand function of the consumer for a single product produced by downstream firm j satisfies:

$$c_j^* = \left(\frac{\phi_j^c}{p_j}\right)^{\sigma} \cdot \frac{I}{\sum_{k=1}^{m} (\phi_k^c)^{\sigma} p_k^{1-\sigma}}, \quad \text{where } \sigma = \frac{1}{1-\rho_c} \tag{17}$$

The value of ρ_c influences the optimization concerning the downstream firms.

Downstream Enterprises

The optimal input quantities for labor, capital, and intermediate goods satisfy the following conditions:

$$\begin{cases} L_j = \dfrac{c_j}{A(\theta_j^D)} \cdot \Psi \cdot \dfrac{\alpha}{\omega} \\ K_j = \dfrac{c_j}{A(\theta_j^D)} \cdot \Psi \cdot \dfrac{\beta}{r} \\ D_j = \dfrac{c_j}{A(\theta_j^D)} \cdot \Psi \cdot \dfrac{1-\alpha-\beta}{p^I} \end{cases} \tag{20}$$

where Ψ represents a common term that recurrently appears in subsequent solutions. Hence, it is defined as follows:

$$\Psi(\omega, r, p^I, \alpha, \beta) \equiv \left(\frac{\omega}{\alpha}\right)^{\alpha} \left(\frac{r}{\omega}\right)^{\beta} \left(\frac{p^I}{1-\alpha-\beta}\right)^{1-\alpha-\beta} \tag{21}$$

Pricing

The pricing strategy and the profit function of firms operating under monopolistic competition. For general taxpayer,

$$p_j^G = \frac{\sigma}{(1-\tau)(\sigma-1)} \cdot \frac{\Psi}{A(\theta_j^D)} \tag{22}$$

For small-scale taxpayer,

$$p_j = \frac{\sigma}{(1-\tau)(\sigma-1)} \cdot \frac{(1+\tau\alpha+\tau\beta)}{(1+\tau)^{\alpha+\beta}} \cdot \frac{\Psi}{A(\theta_j^D)}$$

This result is credible because when $\alpha = 1$, $c_j' = A_\theta L_j$, the price and markup satisfy the form presented in Baqaee et al.(2024)

When $y_\theta = A_\theta l_\theta$

THE SUPPLY-SIDE EFFECTS OF MONETARY POLICY (JPE, 2024)

The profit-maximizing price p_θ^{flex} can be written as a desired markup μ_θ^{flex} times marginal cost. When the firm is able to change its price, the firm's desired price and markup are determined by

$$p_\theta^{\text{flex}} = \mu_\theta^{\text{flex}} \frac{w}{A_\theta}, \qquad \text{and} \qquad \mu_\theta^{\text{flex}} = \mu_\theta\left(\frac{y_\theta^{\text{flex}}}{Y}\right),$$

where the markup function is given by the Lerner formula,[18]

$$\mu_\theta\left(\frac{y}{Y}\right) = \frac{\sigma_\theta\left(\frac{y}{Y}\right)}{\sigma_\theta\left(\frac{y}{Y}\right) - 1}. \tag{3}$$

Lemma 1

引理

The elasticity of substitution among consumer for final goods (ρ_c) influences the relative magnitude of the turnover of downstream enterprises under two distinct taxpayer statuses, which satisfies

$$\begin{cases} p_j c_j^{\text{General}} > p_j c_j^{\text{Small-scale}} & \text{when } 0 < \rho_c < 1 \\ p_j c_j^{\text{Small-scale}} > p_j c_j^{\text{General}} & \text{when } \rho_c > 1 \text{ or } \rho_c < 0 \end{cases} \tag{28}$$

The profit functions of firms also exhibit the same characteristics:

$$\begin{cases} \Pi_j^S > \Pi_j^G & \text{when } \sigma \leq 1 \text{ (i.e., when } \rho_c > 1 \text{ or } \rho_c \leq 0) \\ \Pi_j^S < \Pi_j^G & \text{when } \sigma > 1 \text{ (i.e., when } 0 < \rho_c < 1) \end{cases} \tag{29}$$

TFP

Proposition (1)

The turnover-based VAT thresholds for the two taxpayer classifications correspond to two distinct endowments, and their mathematical expressions are as follows:
General:

$$A(\theta_j^{*1D}) = \kappa_1^{\frac{1}{\rho-1}} \left(\frac{(1-\tau)(\sigma-1)}{\sigma \cdot \Psi} \right)^{-1} \left(\frac{I(\phi_j^c)^\sigma}{\sum_{k=1}^m (\phi_k^c)^\sigma p_k^{1-\sigma}} \right)^{\frac{1}{\sigma-1}} \tag{30}$$

Small-scale:

$$A(\theta_j^{*2D}) = \frac{(1+\tau\alpha+\tau\beta)}{(1+\tau)^{\alpha+\beta}} \cdot \kappa_1^{\frac{1}{\rho-1}} \left(\frac{(1-\tau)(\sigma-1)}{\sigma \cdot \Psi} \right)^{-1} \left(\frac{I(\phi_j^c)^\sigma}{\sum_{k=1}^m (\phi_k^c)^\sigma p_k^{1-\sigma}} \right)^{\frac{1}{\sigma-1}} \tag{31}$$

Identity Selection

Proposition (2)

Given equivalent factor endowment $\theta_j^D < \theta_j^{*D}$, downstream enterprises will opt to apply for general taxpayer status when the profit function under the general taxpayer regime exceeds that of the small-scale taxpayer regime.(i.e., $\sigma > 1$ in lemma). The derivative of the threshold with respect to the VAT rate is:

$$\frac{\partial A(\theta_j^{*1D})}{\partial \tau} = \frac{1}{1-\tau} \kappa_1^{\frac{1}{\rho-1}} \left(\frac{(1-\tau)(\sigma-1)}{\sigma \cdot \Psi} \right)^{-1} \left(\frac{I(\phi_j^c)^\sigma}{\sum_{k=1}^m (\phi_k^c)^\sigma p_k^{1-\sigma}} \right)^{\frac{1}{\sigma-1}} \tag{18}$$

Two Situations

Proposition (3)

When $\sigma > 1$: Firms with endowments $\theta_j^D \in [\underline{\theta}, \theta^{*1D})$ are classified as small-scale taxpayers, while firms with $\theta_j^D \in [\theta^{*2D}, \overline{\theta}]$ are designated as general taxpayers under tax law. Notably, those with endowments $\theta_j^D \in [\theta^{*1D}, \theta^{*2D})$ may still voluntarily choose to adopt general taxpayer status, even if their actual turnover does not exceed the statutory threshold. This decision may be driven by strategic considerations, such as eligibility for input tax credits or supply chain requirements.

When $\sigma < 1$ (also $\theta^{*1D} > \theta^{*2D}$): Firms with endowment $\theta_j^D \in [\underline{\theta}, \theta^{*1D})$ choose to operate as small-scale taxpayers. Even within this context, firms that $\theta_j^D \in [\theta^{*2D}, \theta^{*1D})$ persist in maintaining a small-scale status due to the higher relative profitability associated with this regime. However, for companies with $\theta \in [\theta^{*1D}, \overline{\theta}]$ would nominally designate them as general taxpayers under VAT statutory criteria.

Illustration

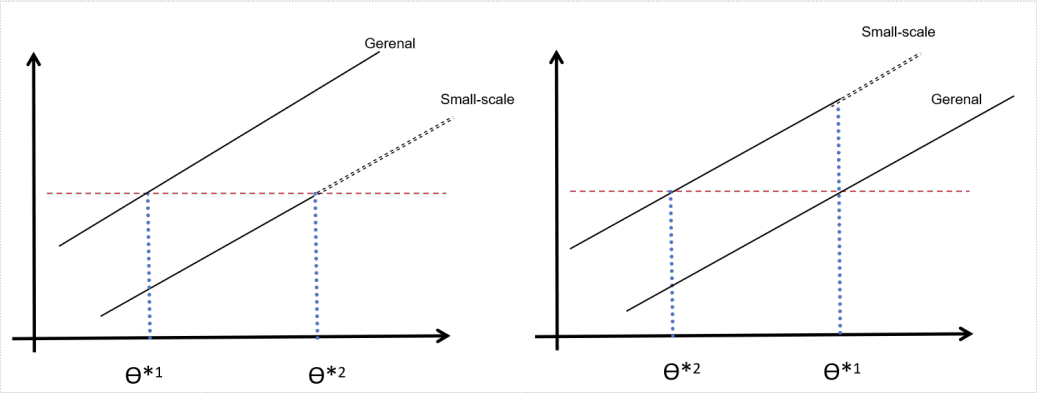

图: Two situation (Due to σ ? 1)

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Future proposal

This vision is a preliminary draft without discussing the upstream and markup.

- Introduce "pass-through" (followed by Baqaee et al., 2024, JPE)

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Future proposal

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- Introduce "pass-through" (followed by Baqaee et al., 2024, JPE)
- Numerical simulation
- Try production network (Diversified products, multiple enterprises)
- Combine frontier theory: New Dynamic Public Finance , New Structural Economics

My concern for next step

- Taxpayer status will affect the choice of transaction partners, especially in downstream.
- Setting of purchasing methods for intermediate goods.
- Empirical evidence of real data. (The universality of such phenomena.)
- Some important points were not taken into consideration...

Looking forward to criticism and suggestions!

Thanks for your time!