A Shopkeeper Economy [*]

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Abstract

This paper investigates the properties of an economy populated by shopkeepers who monopolistically provide differentiated services at zero marginal cost but positive fixed costs. In this setting, equilibrium output and wealth depend on consumer demand rather than available supply. The "shopkeeper economy" is compared to a standard production-based economy in which wealth is a function only of labor supply and technology. I demonstrate that the existence of producers who face only fixed costs provides a counterexample to the notion that "supply creates its own demand."

JEL codes: D24, E22

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1. Introduction

David Ricardo (1817) asserted that 'demand is only limited by production'. A similar assertion, referred to as Say's Law, is 'supply creates its own demand'. [1] These notions underpin the core of modern economic models featuring flexible prices. Under the basic Ricardian framework, output is a function of production technology and supply of factor inputs. Absent any frictions, a marginal increase in output requires a marginal increase in labor supply or labor productivity.

This paper demonstrates that, contrary to the assertions of Ricardo and Say, supply does not create its own demand when firms and workers face fixed, rather than marginal, costs of production. Instead, output is limited by demand when firms or workers face fixed costs but no marginal costs over some range of output. If suppliers choose to pay the fixed cost to increase potential output, that output will only reach its potential if demand is sufficiently high. Otherwise, output will fall below its potential given the available supply of factor inputs.

To help build intuition for this result, consider the cost curve in Figure 1. Contrary to a standard, monotonic and continuously differentiable cost function, the step function depicted contains sequences of flat regions followed by sharp increases. Each sharp increase represents an additional fixed cost, and over the flat region additional output can be supplied at no cost to the firm. If a monopolistically competitive firm is on the flat region of the cost curve, it will set a price based only on the price elasticity of demand (marginal costs are zero). If the resulting quantity demanded is on the flat region of the cost curve, the firm will have spare capacity represented by the distance from the quantity supplied to the vertical portion of the cost curve. In figure 1, spare capacity is represented by the distance between Q and Q* when equilibrium output is Q and the equilibrium price is P.
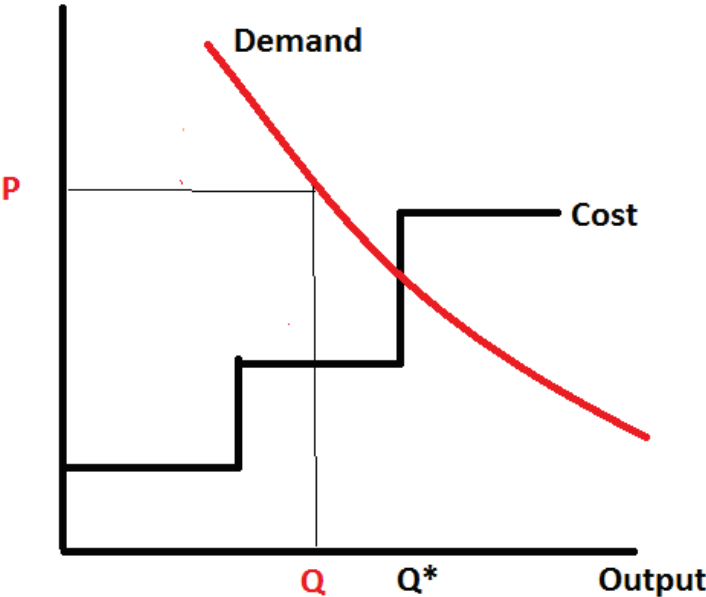
Thus a strong implication of fixed-only costs is the possibility for economic slack, in addition to the dependence of output on demand. Murphy, Schleifer, and Vishny (1989) similarly emphasize the role of fixed costs in generating a role for demand in determining output. In their model, increasing returns generate aggregate demand spillovers such that, if all firms pay a fixed cost to industrialize, the economy experiences a surge in total capacity. Regardless of the level of industrialization in their setup, firms still face marginal costs and the economy is always producing at capacity (whatever that capacity may be). The model below, in contrast, focuses on

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[1] Keynes (1936) termed Say's Law as a summary of the proposition in Say (1967 [1821]).

the role of consumer demand on determining the slack in the economy for a given capacity when firms face fixed-only costs of production.

Strictly fixed costs are typical for shopkeepers such as barbers, who supply labor to man their shop for fixed quantities of time. The fact that the barber supplies his labor for forty hours a week does not immediately translate into forty hours' worth of haircuts. Rather, production of a haircut requires a customer to arrive at the shop. Once the customer arrives, there is no additional time cost to the barber, who has already paid the fixed time cost to man the shop. If the barber knows the demand curve he faces, he will set a price based only on the price elasticity of demand. If demand shifts out (due to an increase in preference for haircuts, for example), the barber will raise the price and provide more haircuts, up to the point at which he is providing haircuts nonstop for forty hours (point Q* in Figure 1).[2]

Figure 1: Cost function with fixed costs.

The model below demonstrates the general equilibrium properties of an economy populated by a non-negligible mass of shopkeepers. It focuses on the simple case of workers who inelastically supply labor to monopolistically competitive firms in a static setting. In the

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[2] A price increase occurs only when the shift in demand is accompanied by a fall in the price elasticity of demand. This will occur, for example, in the linear demand specification in the model below.

model, an increase in preferences for services provided by fixed-cost "shopkeepers" causes an increase in output (up to some capacity limit). This is because the shopkeepers' profit-maximizing price does not by necessity result in capacity output. This result does not hold when firms face marginal costs because the simple assumption of marginal costs implies that additional output requires additional labor input (capacity constraints are effectively assumed away by the presence of marginal costs). There can be no marginal output gain if there is no additional labor input, regardless of the level of consumer demand or the degree of increasing returns to scale.

The model's shopkeepers represent a broad range of firms and workers who face strictly fixed production costs over some range of output. Any firm that pays workers a salary, rather than a piece-rate, faces fixed costs instead of marginal costs. Salary contracts are clearly applicable to many professional service industries, but they also apply to some manufacturing jobs in which employees are paid hourly and guaranteed a quantity of workable hours. Microfoundations for why firms hire labor at a fixed cost include monitoring costs (e.g. Brown 1992) and complementarity with other fixed factors such as capital (Oi 1962).

In many cases, firms face marginal costs of intermediate inputs even if they face fixed labor costs. Restaurants, for example, face marginal ingredient costs. In an economy of restaurants, higher demand for restaurant meals will not increase aggregate output if the food input is produced at a marginal cost. This is because in general equilibrium the higher demand for food increases the derived demand for ingredients, which causes an exactly offsetting increase in the price of food ingredients (assuming the factor inputs are inelastically supplied). However, if the intermediate inputs themselves are produced under strictly fixed costs, then the derived demand for ingredients shifts out the demand curve faced by ingredient producers along the flat portion of their cost curve. Monopolistically competitive producers may increase the price of ingredients, but this price increase will not be large enough to offset the increase in demand. The result will be an increase in output in addition to increases in ingredient prices.

Thus, even if some firms face marginal costs, the existence of strictly fixed costs somewhere along the chain of production permits a role for demand in determining output under inelastic factor supply. As demonstrated in Murphy (2013), the perishable nature of labor supply implies that workers may supply their labor at a fixed time cost; and that the spot market for labor services may feature excess supply when demand is sufficiently low. Therefore even if all

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firms face marginal labor costs, the existence of excess supply and in the labor market generates a role for demand in determining output. The model presented below is an analytically tractable way to capture the prevalence of excess capacity in the labor market and the consumer goods market, and to derive equilibrium implications.

So far I have discussed the effects of shifts in consumer demand. What determines consumer demand? In a standard static model with inelastically supplied labor, demand simply derives from income, which equals supply (the productive capacity of the economy). Demand therefore is dependent on the supply side of the model. In the model below, demand is determined by a preference parameter that represents a range of determinants of demand for goods and services. For example, the demand parameter could represent advertising (coercive or informative), as in Arkolakis (2010). It also captures the stock of consumer goods that complement demand for other consumer goods and services, as in Murphy (2013). In a dynamic setting, it could represent the present value of expected future wealth.

The notion that consumer demand is an important determinant of income, even for a fixed supply of input factors, has a long tradition in economics. Keynes' *General Theory* (1936) was among the first comprehensive works to challenge the notion that production creates its own demand. Keynes attributed shortfalls in demand for goods and services to desired savings in the form of demand for cash rather than for investment. The analysis below abstracts from investment and money, and develops a static, mircofounded equilibrium model with strictly fixed production costs that generates Keynes's prediction of the existence of excess supply.

The proposed model also features comovement between consumer demand and measured total factor productivity (TFP): As demand increases and excess slack falls, output per unit of measured input must increase. Rotemberg and Summers (1990) similarly explore the implications of labor fixity for the cyclicality of TFP. While they study a dynamic setting with fixed prices under uncertainty, the model below is static and prices are always at monopolists' desired levels. A distinguishing feature of the shopkeeper setup is that markups are procyclical, consistent with the evidence in Nekarda and Ramey (2013).

The paper contributes to a burgeoning literature that examines the market implications of consumer demand. Bai, Ríos-Rull, and Storesletten (2013) similarly develop a model in which high consumer demand is associated with high output and TFP. Their model features a search friction that prevents consumers from matching with producers. The microfoundation that

provides a role for procyclical measure TFP in this paper, in contrast, is the fixed nature of production costs. In both models, high demand causes higher output without requiring additional factor inputs. This feature distinguishes the model in Bai et al (2013) and the model below from models of variable utilitzation (e.g. Burnside, Eichenbuam, and Rebelo 1993).

The paper is organized as a series of extensions to illustrate clearly the general equilibrium properties of the shopkeeper economy, and to compare it to economies with marginal costs and/or increasing returns. Section 2 presents the basic model of an economy of individual shopkeepers. Section 3 contrasts the shopkeeper economy to a standard model with marginal labor costs. Section 4 extends the basic model to a setting with fixed labor costs and discusses wage determination. Section 5 shows that the results regarding the importance of demand are robust to the coexistence of a competitive sector with marginal labor costs. Section 6 demonstrates that the demand parameter is irrelevant for output if there are marginal costs everywhere, even in the presence of increasing returns to scale.

Section 7 briefly discusses additional applications of the Shopkeeper Economy and concludes.

2. The Basic Model

The economy is populated by a large mass N of shopkeepers, indexed by n, each of which owns a shop that provides a differentiated service. The shopkeepers inelastically provide the labor required to man the shop, and they set the price of their service to maximize revenue. At the set price, shopkeepers provide the service to meet the consumption demand of the population, which consists of the other shopkeepers.

Services are produced at no marginal cost. Rather, they simply require the time of the shopkeeper. I assume that each shop is below capacity, so that the amount of time spent manning the shop is greater than the amount of time required to meet demand for services. A shopkeeper could represent, for example, a masseuse who spends 40 hours a week at the massage parlor, but only 35 hours massaging customers.

Consumption decision. Shopkeepers have identical utility functions defined over the N services provided in the economy, as well as over a numeraire good y, which is endowed to the economy:

$$U_n = y_n + \int_0^N \delta_i q_{i,n}^c \, di - \frac{1}{2} \gamma \int_0^N \left(q_{i,n}^c\right)^2 di, \tag{1}$$

where y_n is consumption of the numeraire by shopkeeper n and $q_{i,n}^c$ is the consumption of service i by shopkeer n. This utility function is a modified version of the utility functions used by Ottaviano, Tabucci, and Thisse (2002), Melitz and Ottavanio (2008) and Foster, Haltiwanger, and Syverson (2008). The assumption of an endowed numeraire helps simplify the analysis, but the dependence of output on the demand parameter does not rely on the existence of an endowed numeraire, as demonstrated in Appendix A.

The budget constraint of shopkeeper n is

$$y_n^0 + p_n q_n = y_n + \int_0^N p_i q_{i,n}^c \, di, \tag{2}$$

where y_n^0 is shopkeeper n's endowment of the numeraire, p_n is the price of service n, and q_n is the total quantity sold of service n. The first order conditions for y_0^n and $q_{i,n}^c$ are

$$\lambda = 1, \qquad \delta_i - \gamma q_{i,n}^c = \lambda p_i, \tag{3}$$

where λ is the Lagrangian multiplier on the budget constraint. Rearranging (3) gives individual demand for service i by consumer n:

$$q_{i,n}^c = \frac{1}{\gamma} (\delta_i - p_i), \tag{4}$$

which is identical for each consumer. Total market demand q_i is obtained by summing over the demands of all N consumers:

$$q_i = \frac{N}{\gamma} (\delta_i - p_i). \tag{5}$$

Price-setting. Each shopkeeper $i \in [0, N]$ sets the price of his output to maximize revenue/profits, $\Pi_i = p_i q_i$, given the demand for his service. The optimal price is

$$p_i = \frac{1}{2} \delta_i, \tag{6}$$

which implies service quantity

$$q_i = \frac{N}{2\gamma} \delta_i \tag{7}$$

and profits/revenue

$$\Pi_i = \frac{N}{4\gamma} \delta_i^2. \tag{8}$$

Prices and quantities are increasing in the parameter δ_i, which shifts demand for service i relative to demand for the numeraire.

Given a shopkeeper's revenue, we can determine his demand for the numeraire by substituting equations (6) and (7) into the budget constraint, (2):

$$y_n^0 + \frac{N}{4\gamma}\delta_n^2 = y_n + \int_0^N \frac{1}{4\gamma}\delta_i^2. \qquad (9)$$

Rearranging yields

$$y_n = y_n^0 + \frac{N}{4\gamma}\delta_n^2 - \int_0^N \frac{1}{4\gamma}\delta_i^2. \qquad (10)$$

which implies that shopkeeper n's demand for the numeraire will adjust to account for the value of his service (determined by δ_n) relative to the value of the services he consumes. In order to ensure that shopkeeper n has positive demand for all goods and services we must simply assume that y_n^0 is large enough to allow for a positive value for the left-hand-side of equation (10). If we assume that all services provide identical utility, $\delta_i = \delta \; \forall \, i$, equation (10) simplifies to

$$y_n = y_n^0,$$

which implies that each agent's demand for the numeraire is equal to his endowment.

At this point we have a fully-specified economy that satisfies utility maximization, profit maximization, goods market clearing, and satisfaction of agents' budget constraints. Output, prices, and revenues are all increasing in the demand parameters $\{\delta_i\}_{i \in [0,N]}$, but they are independent of the labor input required to actually produce services. Assume for simplicity that all services yield identical utility, $\delta_i = \delta \; \forall \, i \in [0, N]$. Then aggregate output, Q, is obtained by aggregating (7) across all shopkeepers:

$$Q = \frac{N^2}{2\gamma}\delta \qquad (11)$$

Assuming that all shopkeepers are below their capacity constraints, total output is increasing in the demand parameter δ. As we will see below, this apparent contradiction of Say's Law relies on the assumption that some firms face fixed, but not marginal, costs of production.

3. Comparison to a Production-based model

Here we assume that additional firm-level output requires additional labor input, which is the standard assumption in equilibrium models. The mass of agents, as well as the mass of firms, remains fixed at N. Each agent $\{n\}_{n\in[0.N]}$ owns a firm of the identical index. Rather than supplying labor only to their firm, as assumed above, each agent inelastically supplies l units of labor to the labor market, so that total labor supply is $L = lN$. An agent's income therefore consists of his endowment of the numeraire, his wage, and profits from his firm. The budget constraint is altered slightly to

$$y_n^0 + lw + \Pi_n = y_n + \int_0^N p_i q_{i,n}^c \, di, \tag{12}$$

which simply replaces $p_n q_n$ in equation (2) with $lw + \Pi_n$. Utility is the same as above, which implies that equations (1),(3),(4), and (5) apply here as well.

Firms hire workers from the labor market and pay a wage w. Production is linear in labor, so that marginal costs are w for each firm. Firm i maximizes profits,

$$\Pi_i = p_i q_i - w q_i.$$

The profit-maximizing price is

$$p_i = \frac{1}{2}(\delta_i + w), \tag{13}$$

which implies quantity demanded

$$q_i = \frac{N}{2\gamma}(\delta_i - w) \tag{14}$$

and profits

$$\Pi_i = \frac{N}{4\gamma}(\delta_i^2 - w^2) - \frac{N}{2\gamma}(\delta_i - w)w \tag{15}$$

We can use agents' budget constraints to solve for wages and equilibrium output. To simplify the analysis, assume that $\delta_i = \delta \; \forall \; i$. The economy-wide budget constraint is obtained by summing over the budget constraints of the N agents to yield

$$y_n + Lw + \frac{N^2}{4\gamma}(\delta^2 - w^2) - \frac{N^2}{2\gamma}(\delta - w)w = y_n + \frac{N^2}{4\gamma}(\delta^2 - w^2),$$

which simplifies to

$$w = \delta - \frac{2\gamma l}{N}. \tag{16}$$

We can substitute (16) for w in (14) to determine how quantity depends on the model parameters:

$$q_i = l,$$

which implies that total quantity, $Q \equiv \int_0^N q_i di$, is

$$Q = Nl = L. \tag{17}$$

Equation (17) states that in the production economy, total output and income are simply a function of labor supply and are completely independent of the demand parameter δ. Thus, Say's Law applies when all firms face marginal costs of production.

4. Model Extensions: Labor as a Fixed Cost

The model in section 1 delivers the basic structure of an economy of sellers (rather than producers), but it is very simple in that it abstracts from labor and other factor markets. Here we explore how the basic model can be extended to incorporate markets for factors of production. Rather than enter production as a marginal cost, as in Section 3, factor inputs will constitute fixed costs for firms. In this way the model retains the intuition of a shopkeeper/seller economy in which service provision depends on consumer demand rather than on supply capacity. Fixed costs can represent both the labor required to man a shop (such as a cashier), as well as rental payments to land and capital.

We continue to assume a mass N of agents, but in this section we do not require that each agent owns a firm, and thus we do not refer to agents as shopkeepers. Rather, each agent inelastically supplies l units of labor to the labor market. Total labor supply is $L = lN$ There is a mass I of firms, indexed by i, each supplying a differentiated good or service. Agents own an equal share of each firm, although this assumption can easily be relaxed.

Utility is a slightly modified version of (1) to account for the fact that the mass I of firms may differ from the mass N of consumers:

$$U_n = y_n + \int_0^I \delta_i q_{i,n}^c di - \frac{1}{2}\gamma \int_0^I (q_{i,n}^c)^2 di. \tag{18}$$

The budget constraint of agent n is

$$y_n^0 + wl + \frac{1}{N}\int_0^I \Pi_i di = y_n + \int_0^I p_i q_{i,n}^c di. \tag{19}$$

Utility maximization yields the same market demand as (5).

Firm i maximizes profits, which consist of revenues, $p_i q_i$, net of fixed costs f_i:

$$\Pi_i = p_i q_i - f_i.$$

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Profit maximization yields the same optimal price as in (6), resulting in the same resulting market demand as in (7). The resulting profits can be written as

$$\Pi_i = \frac{N}{4\gamma}\delta_i^2 - f_i. \tag{20}$$

Fixed costs are specified in terms of factor input requirements, which for now we assume consist only of labor: $f_i = wL_i$, where L_i is the amount of labor required for firm i to operate. L_i could represent the labor input of, for example, a cashier at a supermarket, a salesman at a furniture store, or a chef at a restaurant. Substituting for f_i in (15) yields

$$\Pi_i = \frac{N}{4\gamma}\delta_i^2 - wL_i. \tag{21}$$

Before proceeding to solve for equilibrium wages and quantities, it is useful to explore the intuition embedded in equation (21). First, profits of firm i are increasing in the demand parameter δ_i and decreasing in the operating labor requirement L_i. Therefore, a firm may shut down due to negative profits if $wL_i > N\delta_i^2/4\gamma$. Firms that survive are those in $I^* = \left\{i \in I : \frac{N}{4\gamma}\delta_i^2 > wL_i\right\}$ for which demand is sufficiently high relative to the firm's fixed cost.

Second, we cannot yet solve for wages. To see this, assume the simplest scenario possible in which firms are identical, $\delta_i = \delta, L_i = L_f$ for all $i \in I$, where δ and L_f satisfy the necessary conditions for nonnegative profits for all firms in I. Total labor demand is IL_f, and the economy-wide budget constraint is

$$y^0 + IL_f w + I\left(\frac{N}{4\gamma}\delta^2 - wL_f\right) = y^0 + I\frac{N}{4\gamma}\delta^2,$$

which simplifies to

$$0 = 0. \tag{22}$$

This indeterminancy result makes sense given that wages are determined neither by labor's marginal product (since labor is a fixed cost at the firm-level) nor by workers' marginal rate of substitution between consumption and leisure (since labor is supplied inelastically). Thus we need another way to pin down the distribution of revenues between firm owners and workers.

One option is to assume a zero-profit condition, in which case all revenues are distributed to workers in the form of wages. The problem with this approach, however, is that when there is heterogeneity in δ_i or L_i across firms, wages will vary across workers in different firms,

$$w_i = \frac{N}{L_i 4\gamma} \delta_i^2,$$

which is inconsistent with wage equalization across identical labor inputs.

Alternatively, assume that in equilibrium all labor is fully employed, $L^d = L$. If there is a good q_j with sufficiently high consumer demand relative to fixed costs, it will enter the market, driving up the price of labor and forcing out firms that were previously on the margin of zero profits. This process will continue until the resulting wage is one in which the wage equalizes revenues and costs for the firm with the lowest ratio of demand to operating labor requirement. If we assume that operating labor requirements are the same across firms, $L_i = L_f \forall\, i$, the wage will be

$$w = \frac{N}{L_f 4\gamma} \underline{\delta}^2, \quad \underline{\delta} = \min\{\delta_i : i \in I^*\}.$$

All firms with $\delta_i > \underline{\delta}$ will have profits $\Pi_i = \frac{N}{4\gamma} \delta_i^2 - wL_f$. Total output results from integrating the quantity demanded from each firm, (7), across firms:

$$Q = \frac{N}{2\gamma} \int_{\underline{i}}^{\bar{\imath}} \delta_i di,$$

where $\underline{i} = \min\{i : i \in I^*\}$ and $\bar{\imath} = \max\{i : i \in I^*\}$. Higher consumer utility over firm output is associated with higher economic output and income.

5. Model Extensions: Production of the Numeraire

In this section we explore the properties of an economy in which a competitive sector coexists with monopolistically provided services that faced fixed operating costs. To do so we assume that the numeraire is produced competitively under constant returns to scale at unit cost. This pins down the wage at unity. The remaining assumptions, including fixed labor costs for other goods, are identical to those in Section 3. We can substitute for wages to rewrite equation (16) as

$$\Pi_i = \frac{N}{4\gamma} \delta_i^2 - L_i. \tag{23}$$

Labor demand is $L^d = y + \int_{i \in I^*} L_i\, di$, which equals labor supply L. Equilibrium conditions will determine the allocation of labor between the numeraire and operating costs for the production of goods $\{i\}_{i \in I^*}$. In the simplest case, $\delta_i = \delta, L_i = L_f \;\; \forall\, i$. Assume $IL_F < L$, so that labor is

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allocated both to production of the numeraire and to the provision of other goods/services. Then the economy-wide budget constraint is

$$L + I\left(\frac{N}{4\gamma}\delta^2 - L_f\right) = (L - IL_F) + I\frac{N}{4\gamma}\delta^2,$$

which again simplifies to

$$0 = 0.$$

As in section 3, profits are higher for firms with higher demand (determined by δ_i), and higher demand leads to higher prices, income, and output. One implication is that even when part of the economy is competitive, income and profits in the monopolistic service sector will be increasing in demand. Therefore, GDP is increasing in demand even when the economy features a perfectly competitive sector, as long as there exists a monopolistic sector with fixed-only costs.

6. Model Extensions: Labor as Fixed and Marginal Cost

Here we combine models of Sections 2 and 3 so that labor is both a fixed cost and a marginal cost for firms. This section provides a comparison to the Krugman (1980) model of increasing returns to scale. Equations (18) and (19) are agents' utility and budget constraint, while (13) and (14) are the optimal price charged by firms and resulting market demand. Profits for firm i are revenues net of fixed and marginal costs:

$$\Pi_i = \frac{N}{4\gamma}(\delta_i^2 - w^2) - w\frac{N}{2\gamma}(\delta_i - w) - wL_i. \tag{24}$$

The economy-wide budget constraint can be written

$$y_n + Lw + \frac{NI}{4\gamma}(\delta^2 - w^2) - \frac{NI}{2\gamma}(\delta - w)w - wL_f = y_n + \frac{NI}{4\gamma}(\delta^2 - w^2), \tag{25}$$

which simplifies to

$$w = \delta - \frac{2\gamma}{NI}(L - IL_f). \tag{26}$$

Equation (26) resembles (16) with an additional term $(L - IL_f)$ to account for fixed costs. We can substitute (26) for w in (14) to determine how quantity depends on the model parameters:

$$q_i = \frac{L}{I} - L_f,$$

which implies that total quantity, $Q \equiv \int_0^I q_i di$, is

$$Q = L - IL_f. \tag{27}$$

Equation (22) states that output is a function only of labor supply and production technology. This result holds both in the short run (fixed I) and when profits are zero in the long-run.[3]

8. Conclusion

This paper has demonstrated that when some firms face only fixed, rather than marginal, costs of production, high demand will lead to high income and output in general equilibrium. The result does not hold under the prevailing assumption in economic models that all producers face marginal production costs. Intuitively, the assumption of marginal costs of production amounts to an assumption that the economy is at capacity. This is true even if the production technology features increasing returns to scale.

For an economy of marginal costs to increase output and take advantage of returns to scale, it must increase capacity by increasing supply. In the absence of a supply increase, an increase in demand has no general equilibrium effects on output. In an economy in which some producers face only fixed costs, high demand removes some of the slack inherent in the economy.

The static model presented above is a natural and simple setting through which to understand the implications of fixed-only costs. Extensions of the static model may have interesting implications for optimal tax policy, the gains from trade, the nature of unemployment, and other areas of economics that to date have been examined through the lens of models that embody Say's Law. These extensions, as well as dynamic models that feature fixed-only costs, are left for future work.

References

Arkolakis, Costas. 2010. "Market Penetration Costs and the New Consumers Margin in International Trade." *Journal of Political Economy*. 118(6): 1151-1199.

Bai, Yan, José-Víctor Ríos-Rull, and Kjetil Storeletten. "Demand Shocks as Productivity Shocks." Federal Reserve Board of Minneapolis.

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[3] Note that equation (27) will hold for any number of firms I, including the long-run equilibrium level I^*. Numerical simulations confirm that Q is invariant to δ in the long-run equilibrium.

Brown, Charles. 1992. "Wage Levels and Method of Pay." *The RAND Journal of Economics*. 23(3): 366-375.

Burnside, Craig, Martin Eichenbaum, and Sergio Rebelo. 1993. "Labor Hoarding and the Business Cycle." *Journal of Political Economy* 101(2): 245-273.

Keynes, John M. 1936. "The General Theory of Employment, Interest, and Money." London: Macmillan.

Krugman, Paul. 1980. "Scale Economies, Product Differentiation, and the Pattern of Trade." *American Economic Review* 70(5): 950-959.

Melitz, Marc J. and Giancarlo I.P. Ottaviano. 2008. "Market Size, Trade, and Productivity." *Review of Economic Studies* 75: 295-316.

Murphy, Daniel P. 2013. "Excess Supply in the Spot Market for Labor." University of Virginia.

Murphy, Daniel P. 2013. "Why are Goods and Services more Expensive in Rich Countries? Demand Complementarities and Cross-Country Price Differences." RSIE Working Paper 636.

Murphy, Kevin M., Andrei Schleifer, and Robert W. Vishny. 1989. "Industrialization and the Big Push." *Jounral of Political Economy*. 97(5): 1003-1026.

Nekarda, Christopher J. and Valerie A. Ramey. 2013. "The Cyclical Behavior of the Price-Cost Markup." UCSD Mimeo.

Oi, Walter Y. 1962. "Labor as a Quasi-Fixed Factor." *Journal of Political Economy*. 70(6): 538-555.

Ottavanio, Giancarlo. I. P., Takatoshi Tabuchi. and Jacques-François Thisse. 2002. "Agglomeration and Trade Revisited", *International Economic Review*, 43, 409–436.

Rotemberg, Julio J. and Lawrence H. Summers. "Inflexible Prices and Procyclical Productivity." *Quarterly Journal of Economics*. 105(4): 851-874.

Say, Jean-Baptiste. 1967 (1821). "*Letters to Mr. Malthus on Several Subjects of Political Economy.*" Translated by John Richter. New York: Augustus M. Kelly.

Appendix A

In this section I demonstrate that the economy without an endowed numeraire yields identical demand for services as in the shopkeeper economy of Section 2, although with a loss of analytical simplicity. Agents have identical utility given by

$$U_n = \int_0^I \delta_i q_{i,n}^c \, di - \frac{1}{2} \gamma \int_0^I (q_{i,n}^c)^2 \, di. \tag{28}$$

As in Section 3, I allow the number of firms I to differ from the size of the population N. Likewise, assume that agents own an equal share of each firm, and that each firm pays a fixed operating cost wL_f.

Agent n's first order condition is $\delta_i - \gamma q_i = \lambda p_i$, where λ is the multiplier on the agent's budget constraint. Then demand for good i by agent n.

$$q_{i,n}^c = \frac{1}{\gamma} (\delta_i - \lambda p_i),$$

and market demand is

$$q_i = \frac{N}{\gamma} (\delta_i - \lambda p_i)$$

Then market demand Firm i sets the price of its output to maximize profits, $\Pi_i = p_i q_i$. The optimal price at which marginal revenue is zero is

$$p_i = \frac{\delta_i}{2} \lambda. \tag{29}$$

Given the price, the resulting quantity demanded by agent n is

$$q_{i.n}^c = \frac{1}{2\gamma} \delta_i, \tag{30}$$

and total market demand is

$$q_i = \frac{N}{2\gamma} \delta_i \tag{31}$$

Interestingly, the quantity demanded does not depend on agents' income. Nonetheless, equations (30) and (31) satisfy the agent's budget constraint,

$$lw + \frac{1}{N} \int_0^I \left(\frac{N}{4\gamma} \delta_i^2 - wL_f \right) di = \int_0^I \frac{1}{4\gamma} \delta_i^2 \, di,$$

which simplifies to

$$I = \frac{L}{L_f} \tag{32}$$

Equation (32) simply states that the number of viable firms in equilibrium depends on the fixed cost per firm relative to the labor supply. As in Section 2, quantities are increasing in δ_i for each good i. We can normalize the price of any good to unity. If $\delta_i = \delta \ \forall \ i$, equation (29) reduces to

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$p = p$ due to the fact that all goods are assumed identical, and any good can serve as the numeraire. Normalizing the price to unity implies that quantities and incomes are increasing in δ.