Finance and Competition*

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Abstract

Financial constraints are commonly thought as representing a barrier to entry and expansion for new and small firms, thus potentially limiting competition in product markets. We investigate the role of financial constraints for product markets in the context of a general equilibrium, two-sector model, where firms differ in terms of both efficiency and financial constraints. The amelioration of financial constraints can lead to firm entry, smaller average firm size, lower concentration and more competition (lower markups) in financially dependent sectors – the patterns observed in the data – if such constraints afflict disproportionately the smaller firms. This requires a positive correlation between ability and capital ownership. In all other cases, the amelioration of constraints leads to greater concentration and to an ambiguous effect on competition. Some incumbents will oppose while others will favor financial liberalization.

JEL Codes: L1, E2.

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1 Introduction

Does the existence of financial constraints hinder product market competition in financially dependent sectors? In particular, do such constraints matter for the number and size of firms as well as for concentration and markup indexes in these markets? There is a strong presumption, based on the notion that financial constraints act as a barrier to entry/expansion in financially dependent activities, that a more developed financial system is conducive to greater product market competition. Surprisingly, though, there exists no theory linking asset market development to competition. And the empirical evidence that could be used to judge this relationship is indirect as it comes mostly from studies of how competition in the banking system affects product market competition. Banking competition and financial development are not necessarily synonymous.

The empirical literature on finance and competition is quite meagre. It has studied the effects of either financial development (Rajan and Zingales (1998), Haber (2000)) or of changes in the degree of competition in the banking sector (Cetorelli and Strahan (2006), Bertrand, Schoar and Thesmar (2007)) on several measures of market structure and performance. Rajan and Zingales find that financial development increases the number of firms while it has an ambiguous effect on average firm size in financially dependent industries. Haber compares the cotton industries in Brazil and Mexico during 1880-1930, a period of financial liberalization, and argues that concentration indexes decreased, in particular in Brazil, the country that underwent the most effective financial market reform. Cetorelli and Strahan study how market structure in nonfinancial sectors was affected by the increase in "competition" –lower bank concentration and looser state-level restrictions– following deregulation in state banking in the US. They find that the number of firms increased, average size (number of employees per establishment) and concentration decreased, and the share of establishments in the smallest size group also increased. Similarly, Bertrand, Schoar and Thesmar examine the effects of lower state intervention (deregulation) in the French banking industry on performance and competition in financially dependent sectors. They find an increase in firm entry and exit rates and also a reduction in the level of product market concentration.

It thus appears that developments in the financial markets that increase the availability of credit (such as financial liberalization/development or increased financial competition) tend to encourage entry and to lead to lower concentration and more competition in product markets. Does this have a theoretical basis?

The theoretical literature on finance and product market competition is quite extensive but, at the same time, quite narrow in scope. It has two key features. First, it is partial equilibrium. Second, it is exclusively concerned with the *strategic* relationship between financial decisions and output market decisions when both financial and product markets are imperfectly competitive. One strand of the literature studies how investors (financial intermediaries) select financial contracts or instruments in order to influence the funded firm's – as well as its rivals' – competitive behavior: pricing decisions, the incentive to enter, the incentive to collude, the choice to compete in strategic complements vs substitutes, and so on.[1] The other strand studies the reverse question, namely, how firms select the financial contracts or instruments in order to influence the investor's incentives to finance other firms (whether or not to provide funds to potential entrants, to rivals of the firms and so on[2]).

The objective of this paper is to provide a general framework for the study of the relationship between financial constraints and competition in product markets. Our analysis contains four novel elements relative to the existing literature. First, it is general equilibrium. As such, it captures the macroeconomic effects of changes in the functioning of financial markets. Second, it allows financial markets to matter even when they are perfectly competitive. Third, it allows for heterogeneity in efficiency across firms. And forth, it allows for differences in the degree of financial constraints across firms. In addition to providing insights into the link between finance and competition, the model can also be used to shed light on the political economy of financial liberalization/development (under what conditions do incumbents object to liberalization?).

We employ a general equilibrium, two-sector model, with heterogeneous agents. The

[1]Brander and Lewis (1986) is the pioneering work. See Cestone and White (2003) for a discussion of the literature and further references.

[2]Cestone and White (2003).

agents may differ with respect to their productivity level as well as to their wealth holdings (determining their need for external finance). One sector (sector 1) is financially dependent in the sense that production depends on the amount of capital used and capital may need to be borrowed from the financial system.[3] This sector is also imperfectly competitive, with firms competing *a la* Cournot. In the other sector (sector 2), productivity is independent of capital and the market structure is perfectly competitive. There is free entry in both sectors.

We use this model to compute the general equilibrium with and without financial markets[4] and then address the following questions. How does the amelioration of financial constraints affect the economy's total output and its composition, as well as the quantity and prices of the goods produced in capital dependent sectors? How does it affect the number and size of firms in these sectors? Does the degree of product market *competition*, as measured by standard indicators of market shares and markups, increase or decrease following the elimination of financial constraints? And what is the role played by the joint distribution of wealth and ability?

We find that financial markets make the output of the financially dependent sector expand and its price drop. This is consistent with the finding of Rajan and Zingales (1998) that industries that are more dependent on external finance grow relatively faster in more financially developed countries. It arises from the fact that financial development expands *asymmetrically* the economy's production possibilities frontier.

The implications for the number of firms, firm size, market concentration indexes and markups are more intricate. They depend critically on the properties of the joint distribution of ability and wealth. If financial constraints represent a limit to capacity mostly for the largest firms, then their relaxation leads to firm exit, to an increase in concentration indexes and average firm size, and to a decrease in competitiveness (as measured by the standard Lerner concentration index).

[3]In order to keep the analysis tractable, we abstract from uncertainty, agency problems and so on. The sole role of the financial system in our model is to allocate funds from multiple savers toward investment projects.

[4]One could easily consider intermediate cases of financial market imperfections without affecting the main results.

If, on the other hand, financial constraints affect mainly smaller firms and potential entrants,[5] then the relaxation of constraints is likely to produce firm entry, a decline in concentration and average firm size and an improvement in competition (markups decrease).

Our model can thus generate behavior consistent with the empirical evidence under the assumption that financial constraints afflict mostly the small and the new or equivalently, that ability and wealth are positively correlated. Both conditions seem to capture the conventional wisdom on this issue.[6]

The model also has implications regarding the political economy of financial liberalization. A popular view is that the development of financial markets is hindered by the power of incumbents. This includes both incumbent financial institutions that are concerned about competition in the financial market, as well as incumbent firms that fear that a more competitive financial system will finance entrants into their sectors. The model shows that incumbency may not always be sufficient to characterize preferences towards financial liberalization. There may be incumbents who will support liberalization (efficient but undercapitalized producers), as well as incumbents who may object to it (efficient and well capitalized firms). It is the fact that there are situations where the financial markets tend to favor disproportionately the most efficient but poorly capitalized producers that can account for such divisions within the class of incumbent firms.

The paper proceeds as follows. In the next section, we present our model. Section 2 describes the model, results are presented in section 3, section 4 provides some generalizations, and section 5 concludes.

[5] In our model this arises when ability and wealth are positively correlated.

[6] While Rajan and Zingales report that it is the larger firms that are more sensitive to financial developments – see their Table 8 – this represents an unusual finding. For instance, Cetorelli and Strahan find little effect of greater bank competition on the large firms.

2 The Model

2.1 The Environment

Preliminaries The economy is populated by a finite number of individuals N. Individuals differ with respect to their ability level and private wealth holdings. Let $\mathcal{A}$ and $\mathcal{K}$ denote the corresponding sets of ability and wealth. We have $\mathcal{A} = \{a_j\}_{j=1}^{N}$ and $\mathcal{K} = \left\{\bar{k}_l\right\}_{l=1}^{N}$. Individual i is defined by a pair $\left(a_i, \bar{k}_i\right) \in \mathcal{A} \times \mathcal{K}$, $i = 1, \ldots, N$. $\bar{K}$ denotes the economy's global endowment of capital, given by $\sum_i \bar{k}_i$. Ability and wealth holdings are publicly observed and common knowledge. $F(a, k)$ denotes the joint cdf of ability and wealth in the economy.[7]

Production There are two goods produced in this economy. Good 1 requires capital as an input. If individual i works in sector 1, its output q_i is

$$q_i = a_i k_i^{\beta} \tag{1}$$

with $\beta \in (0, 1)$. k_i is the amount of capital individual i invests in production.

Output in sector 2 is independent of ability and, moreover, it does not require the use of any capital. If individual i chooses to work in sector 2, he produces A units of good 2.

In the presence of financial markets, individuals may borrow capital if their desired scale of operations exceeds their individual capital holdings. Without financial markets, individual investment is constrained to satisfy:

$$k_i \leq \bar{k}_i \tag{2}$$

Since the ability to borrow affects the scale of individual production in sector 1 but not in sector 2, sector 1 is said to be a financially dependent sector.

[7] We make the assumption of finite N since it seems more in line with deviations from price-taking behavior. However, in the remainder of the paper, we effectively treat the economy as continuous.

Preferences Individuals have utility defined over two goods. Given a consumption vector (c_1, c_2), total utility is

$$u(c_1, c_2) = \log(c_1) + \gamma \log(c_2)$$

for $\gamma > 0$. Let p be the relative price of good 1 in terms of good 2.

Wealth endowments, $\bar{k}_l \in \mathcal{K}$, are expressed in units of good 2. The income, l_i, of an individual i who chooses to operate in sector 1 is:

$$l_i = \bar{k}_i + (pq_i(k_i) - k_i).$$

and that of one who operates in sector 2:

$$l_i = A + \bar{k}_i$$

Individuals buy (or sell) the difference between $\bar{k}_i$ and k_i at the price of one.

Aggregate Demand The budget constraint for i is:

$$pc_i^1 + c_i^2 = l_i$$

Given an income level l_i, the demand for goods 1 and 2 is:

$$c_i^1 = \frac{1}{p}\frac{l_i}{1+\gamma}, \quad c_i^2 = \frac{\gamma}{1+\gamma} l_i$$

Since Engel curves are straight lines from the origin, we have a representative agent economy. Aggregate demand depends only on aggregate income (the sum of individual income across individuals) and not on how it is distributed. Define

$$I \equiv \sum_{i=1}^{N} l_i$$

so that I is aggregate income. Aggregate demand for good j, denoted C^j, is then

$$C^1 = \frac{1}{p}\frac{I}{1+\gamma}, \quad C^2 = \frac{\gamma}{1+\gamma} I.$$

The inverted demand curve for good 1 is:

$$p = \frac{1}{C^1}\frac{I}{1+\gamma} \tag{3}$$

Due to the log preference specification the (absolute value of the) elasticity of demand of good 1 with respect to its relative price p is equal to 1. The relative demand schedule of good 1 in terms of good 2 is:

$$\frac{C^1}{C^2} = \frac{1}{p}\frac{1}{\gamma} \tag{4}$$

Next, we examine the economy without financial constraints.

2.2 Financially Unconstrained Economy

We first describe how a firm that has chosen sector 1 selects its optimal level of production. We then describe how firms choose their sector of activity.

2.2.1 Optimal Choice of Level of Production in Sector 1

Consider an individual i, with ability level a_i. The profits from operating in sector 1 are:

$$\pi_i^1 = p\left(Q_1\right) q_i - k_i = p\left(Q_1\right) q_i - \left(\frac{q_i}{a_i}\right)^{\frac{1}{\beta}} \tag{5}$$

where q_i is the quantity produced by individual i, k_i the amount of capital used, Q_1 the total output of good 1 produced, and $p\left(Q\right)$ the inverse demand curve for good 1. We assume that sector 1 is characterized by quantity competition *a la* Cournot, while sector 2 is perfectly competitive.

Under Cournot competition, each firm chooses output q_i taking the quantities of the remaining firms as given. The first-order condition for firm i is:

$$p\left(1 - \frac{q_i}{Q_1}\right) = MC\left(q_i\right) \tag{6}$$

where $MC\left(q_i\right)$ indicates firm i's marginal cost. We thus obtain the familiar result that the price to marginal cost ratio, the markup, equals $\left(1 - q_i/Q_1\right)^{-1}$.

Equation (6) defines firm i's optimal quantity q_i in terms of the relative price p, total market output Q_1, and level of efficiency, a_i. Optimal quantity q_i is strictly increasing in ability. Holding p and Q_1 constant, more able firms will have greater market shares and higher markups than less able ones. Since the marginal cost declines with ability, more able firms are more profitable than less able ones.

Equation (6) allows us to solve for the optimal quantity produced by firm i, q_i^*. It can be written as:

$$q_i^* = q_i^* \left(\overset{+}{p}, \overset{+}{Q}_1, \overset{+}{a}_i \right) \tag{7}$$

Using the production function, equation (7) can be rewritten in terms of capital:[8]

$$k_i^* = k_i^* \left(\overset{+}{p}, \overset{+}{Q}_1, \overset{+}{a}_i \right) \tag{8}$$

It follows that more able firms choose a larger scale of production.

2.2.2 Optimal Choice of Sector of Activity

Individuals choose to work in the sector that generates the highest income. Let us consider the minimum amount of capital, k_{min} that makes an individual of ability level a indifferent between the two sectors. $k_{\min}(a, p)$ is thus determined by the equation:

$$pa_i k_{\min}^{\beta} - k_{\min} = A \tag{9}$$

Equation (9) defines a relationship between ability and capital. It can be verified that $k_{\min}(a, p)$ is decreasing and convex in ability. Moreover, since a higher price raises profits for given levels of ability and capital, an increase in p shifts the $k_{\min}(\cdot)$ schedule downwards in (a, k) space.

Under appropriate assumptions on the distribution of ability and the parameters of the model, there exists a level of ability, $\tilde{a}$, such that

$$k_{\min}(p, \tilde{a}) = k^*(p, \tilde{a}, Q_1) \tag{10}$$

In a financially unconstrained economy, the ability level $\tilde{a}$ is the threshold determining the separation of entrepreneurs into activities: those whose ability exceeds $\tilde{a}$ work in sector 1 whereas the remaining work in sector 2. This threshold is implicitly defined by equation (10) as a function of p and Q_1:

$$\tilde{a} = \tilde{a}(p, Q_1) \tag{11}$$

[8]The strictly monotonic relationship between ability and capital depends on an additional condition that no firm holds a market share in excess of 50% of Q_1. If ability levels are not too far apart, this will be the case.

Note also that the schedule k_{min} is not defined for ability levels below $\tilde{a}$ because these individuals can never earn more than A. Equations (8) and (9) are depicted in Figure 1.

Once the choice of activity has been made and production completed, the aggregate supply of good 1, Q_1, is given by

$$Q_1 = \sum_{a_i \geq \tilde{a}(p,Q_1)}^{\bar{a}} q_i^* \left(\overset{+}{p}, \overset{+}{a_i}, \overset{+}{Q_1} \right). \tag{12}$$

Total input demand for good 1 production, K^*, is:

$$K^* = \sum_{a_i \geq \tilde{a}(p,Q_1)}^{\bar{a}} \left(\frac{q_i^*}{a_i} \right)^{\frac{1}{\beta}}. \tag{13}$$

Let Q_2 denote the total quantity of good 2 produced in the economy:

$$Q_2 = \sum_{a_i \leq \tilde{a}(p,Q_1)} A. \tag{14}$$

The quantity of good 2 available for consumption is

$$C_2 = Q_2 + \bar{K} - K^* \tag{15}$$

where $\bar{K}$ is the economy's initial endowment of capital and K^* the amount used up in production in sector 1.

2.2.3 The Equilibrium

Definition 1 *An equilibrium in the financially unconstrained economy is a triple* $\left(\tilde{a}, p, \{q_i\}_{i=1}^N \right)$, *with* $Q_1 = \sum_{i=1}^N q_i$, *such that:*

i) q_i *satisfies (6) for* $a_i \geq \tilde{a}$ *and is equal to zero for* $a_i < \tilde{a}$;

ii) $C_1 = Q_1$, $C_2 = Q_2 + \bar{K} - K^*$;

iii) Equation (4) is satisfied.

In order to construct the equilibrium one can proceed as follows. Use (10) to solve for $\tilde{a} = \tilde{a}\,(p, Q_1)$ (see Figure 1). Substituting this expression into (12), (13) and (14) yields

Q_1, Q_2 and K^*, respectively, as functions of p. Substituting Q_1 for C_1 and $Q_2 + \bar{K} - K^*$ for C_2 in (4) determines p. In our economy, an unconstrained equilibrium exists and is unique[9].

Note that in the special case of equal ability $a_i = a, \ \forall i$, the equilibrium involves a triple (n, p, q) such that: for $i \geq n, \ q_i = q$ and for $i < n, \ q_i = 0$; and conditions (ii) and (iii) in the definition of the equilibrium (definition 1) are satisfied with $\sum_{a_i \geq \tilde{a}}$ being replaced by $i \geq n$. Hence, n identical firms operate in sector 1 and $N - n - 1$ identical agents work in sector 2.

2.3 Financially constrained economy

We now discuss the determination of the equilibrium in this economy in the *absence* of financial markets.[10] The superscript c is used to indicate equilibrium values in the constrained economy. Let q_i^c denote individual i 's output in the constrained environment. If this entrepreneur cannot use external funds, then his production in sector 1 cannot exceed the level that could have been financed by his own initial capital stock, $\bar{k}_i$:

$$q_i^c = min\{a_i \bar{k}_i^{\beta}, a_i (k_i^*)^{\beta}\} \tag{16}$$

where k_i^* is determined by equation (8).

Unlike the financially unconstrained economy, the choice of activity now depends on both individual ability and individual wealth. The threshold ability level for the choice of activity in the financially constrained economy, $\tilde{a}^c$, as well as the corresponding amount of capital, $k_{\min}(\tilde{a}, p)$, are then determined by combining equations (8), (9) and (16). All individuals with ability $a \geq \tilde{a}^c$ who have wealth $k \geq k_{min}(a)$ will operate in sector 1. The rest, those who are not simultaneously able and rich enough to operate in sector 1, will work in sector 2.

[9]Since marginal cost is increasing, the production of greater quantities of good 1 requires increasing amounts of capital as well as an increasing number of entrepreneurs. Both forces show that, as C_1 increases, an increasingly greater amount of C_2 must be foregone to generate an extra unit of C_1. This shows that the consumption possibilities frontier of the economy is strictly concave. The $\log(\cdot)$ preference format generates strictly convex indifference curves and, therefore, the tangency point is unique.

[10]While for reasons of simplicity we study an economy without any asset trade, our analysis is applicable to more general environments with asset markets but with restricted asset trade.

The Equilibrium

Definition 2 *An equilibrium in the financially constrained economy is a triple* $\left(\tilde{a}^c, p^c, \{q_i^c\}_{i=1}^N\right)$, *with* $Q_1^c = \sum_{i=1}^N q_i^c = \sum_{i=1}^N a_i (k_i^c)^\beta$, *such that:*

ia. ${k_i}^c = \min\{k_i^*, \bar{k}\}$ *if* ${k_i}^c \geq k_{min}$ *and zero otherwise*

ib. k_i^* *satisfies (8) and* k_{min} *satisfies (9)*

ii. $C_1 = Q_1$, $C_2 = Q_2 + \bar{K} - K^*$

iii. Equation (4) is satisfied.

Conditions (ia-ib) state that a firm will operate in sector 1 if it is profitable and affordable to do so. If it operates, it will either produce its optimal quantity –if unconstrained– or, if constrained, the quantity allowed by its capital stock.

Note that, in the special case of equal ability and a common level of wealth, $a_i = a, \ \forall i$, $\bar{k}_i = k, \ \forall i$, the equilibrium involves a triple (n^c, p^c, q^c) such that: for $i \geq n^c, \ q_i^c = q^c$ and for $i < n^c, \ q_i^c = 0$; and conditions (ii) and (iii) in the definition of the equilibrium (definition 2) are satisfied with $\sum_{a_i \geq \tilde{a}}$ being replaced by $i \geq n^c$. Hence, n^c identical firms operate in sector 1 and $N - n^c - 1$ identical agents work in sector 2.

3 The effects of financial markets

Before proceeding, we next define formally the measures of competition used in the remainder of the paper.

Concentration Indexes

Let us order the firms by size so that 1 represents the largest firm, 2 the second largest firm and so on. Then,

Definition 3 *The* H_j *index of the market share of the* j *largest firms is defined as:*

$$H_j \equiv \sum_{i=1}^{j} \frac{q_i}{Q_1}.$$

Markups

Definition 4 *The markup of firm i, μ_i is given by $\mu_i = (p - MC_i)/p$. When a firm is unconstrained, its markup is determined from the first-order condition, equation (6):*

$$\mu_i \equiv \frac{p - MC_i}{p} = (1 - \frac{q_i}{Q_1})^{-1} \tag{17}$$

And when constrained and producing suboptimal quantity $q(\bar{k})$ by:

$$\mu_i \equiv \frac{p - MC_i}{p} = \frac{p - MC\left(q(\overline{k})\right)}{p} \tag{18}$$

Definition 5 *The Lerner index of monopoly, σ, is defined as*

$$\sigma \equiv \sum_{a_i \geq \tilde{a}} \mu_i \frac{q_i}{Q_1} \tag{19}$$

A lower value of σ signifies a smaller divergence from the resource allocation that would have obtained under perfect competition.

Definition 6 *Let H_j^c denote the sum of the market shares of the j largest firms in the constrained economy, and define H_j^u similarly for the unconstrained case. We say that market concentration increases following financial liberalization if there is a number $j \geq 1$ such that, $\forall l \leq j$:*

$$H_l^u > H_l^c. \tag{20}$$

Conversely, we say that market concentration decreases following financial liberalization if the previous inequality is reversed for some $j \geq 1$, $\forall l \leq j$.

We now study the implications of financial constraints for the allocation of resources (output levels and number of firms), the relative price of the financially dependent good, markups and market concentration. In order to highlight the role played by the distributions of ability and wealth, it is instructive to present first the case where agents are perfectly homogeneous with regard to both ability and wealth. We then separately introduce heterogeneity in ability and in wealth and, finally, we combine heterogeneity in both dimensions.

3.1 The homogeneous case

With identical ability, $a_i = a, \ \forall i$, and initial wealth, $\bar{k}_i = k, \ \forall i$, all firms operating in sector 1 produce the same level of output and have the same profits. In an interior equilibrium, whether in a financially constrained economy or not, agents must be indifferent between the two sectors. That is, the equilibrium satisfies the condition

$$pak^{\beta} - k = A \tag{21}$$

where $k = \bar{k}$ in the constrained economy, and $k = k^*$ in the unconstrained economy. By construction $\bar{k} < k^*$ (otherwise the financial constraint does not bind), that is, the firms are bigger in the unconstrained economy. Equation (21) then implies $p^c > p^u$. Equation (4) implies that Q_1/C_2 must increase with the amelioration of the financial constraints, which, through the aggregate economy resource constraint dictates that Q_1 increase.

While average firm size increases, the effect on the number of firms cannot be determined without additional assumptions. In order to get more concrete results we have solved the model numerically for a large set of parameter values. Following the lifting of financial constraints, we always find that firm *exit* takes place (see Table 1). Based on the numerical results, we take the case with firm exit to represent the most likely outcome of financial amelioration. Conditional on exit, concentration increases (all firms remaining in sector 1 gain market share), although markups and the Lerner index decline, as $p^u < p^c$ and $MC^u > MC^c$.

We draw two conclusions from these findings. First, an increase in market concentration and/or a reduction in the number of firms does not necessarily imply a worsening of competitive conditions (a common belief that underlies policy in this area), at least in the presence of additional distortions (such as financial imperfections); price-cost margins are a more reliable indicator. And second, the model cannot deliver results consistent with the empirical evidence (namely entry and reduction in concentration) in the absence of some sort of heterogeneity. Further, a fully homogeneous environment produces a degenerate distribution of firm sizes, also an unpalatable outcome. In the next subsection we examine whether heterogeneity in efficiency (ability) can improve the performance of the model.

3.2 Heterogeneous ability

We maintain the assumption of identical initial wealth, $\bar{k}_i = k, \ \forall i$, but now assume that ability varies across individuals such that $a_i > a_j \iff i < j$. There are two possibilities regarding the incidence of financial constraints: either they affect some or they affect all of the agents. Note that, in the former case, it is the largest firms that are constrained because they have a larger optimal scale of operation. The two cases are depicted in Figures 2 and 3 respectively. The solid lines correspond to the financially constrained economy while the dashed ones to the unconstrained one.

We establish that the equilibrium relative price of the financially dependent good, p, decreases while its quantity, Q_1, increases with the amelioration of the financial constraints (Proposition 1). The effect on the number of firms seems ambiguous. When only the largest firms are constrained, financial deepening triggers firm exit. Average firm size and market concentration increase but the effect on the Lerner concentration index is ambiguous. (Although the markups of all incumbent firms decline, the firms that drop out had the lowest markups in the constrained environment.)

When all firms are constrained, then either firm exit or entry seems possible. Nonetheless, when solving the model numerically for a wide range of parameter values, we always find that exit takes place. With firm exit, the same patterns described above are obtained: higher average firm size and concentration as well as an ambiguous effect on the Lerner index. If we interpret these patterns as representing the most likely outcome of financial liberalization in an economy with a single level of initial wealth, then we must conclude that heterogenous ability per se does not bring us closer to matching the empirical facts on entry and concentration. In the next section, we examine the case where ability is again constant but where wealth varies across people.

Let $\left(p^u, \tilde{a}^u, \{q_i^u\}_{i=1}^N\right)$ denote the equilibrium in the unconstrained economy, and $\left(p^c, \tilde{a}^c, \{q_i^c\}_{i=1}^N\right)$ denote the equilibrium in the constrained economy. We summarize the findings of this section in the next three propositions. Their proofs can be found in the appendix.

Proposition 1 *The amelioration of financial constraints leads to a lower relative price*

and a higher quantity of the financially dependent good.

Proposition 2 *If financial constraints affect disproportionately the large firms*[11]*, then the amelioration of financial constraints results in firm exit from sector 1:* $\tilde{a}^c < \tilde{a}^u$.

Table 2 presents the findings from the numerical solution of the model. As mentioned above, we have solved the model over a wide range of parameter values without being able to produce any examples of firm *entry*. In our discussion of the implications of the model for concentration and markups we limit ourselves to the case of firm exit[12].

Proposition 3 *The elimination of financial constraints leads to higher market concentration but has an ambiguous effect on the Lerner index.*

This is an important finding as it reveals the existence of potential conflict between alternative measures of competition. In a world with heterogeneous producers, higher concentration does not necessarily mean greater divergence from the competitive allocation.

3.3 Heterogeneity in wealth

Here, we consider the case where ability is constant but wealth varies across individuals. Once again, two scenarios may emerge. In a high wealth economy, it is only the smallest, least wealthy firms that are financially constrained. In the low wealth case, no single entrepreneur in the economy has sufficient wealth to attain the optimal scale of operations: all firms are constrained. The first case – high wealth individuals are unconstrained even when the economy lacks financial markets – differs in important ways from the situation where ability is heterogeneous but wealth is constant. In that case, even when some firms could operate unconstrained, it was the lowest ability – and therefore the smaller firms – that operated unconstrained. Here, it will be the largest firms operating unconstrained, if any, since those now correspond to the high wealth individuals whose deep pockets allow them to bypass the financial market.

[11] If financial constraints bind for all firms, then the effect on entry is ambiguous.
[12] However, one can easily describe what would happen were entry to occur.

In this environment, it also follows that a lower relative price p and higher good 1 production Q_1 result from financial liberalization. In fact, the proof of Proposition 1 is general enough to accommodate all the cases considered here. Under perfect financial markets, wealth differences are irrelevant and all good 1 producers generate exactly the same quantity, q^u. Absent such markets, we will have a distribution of output values closely related to the distribution of wealth. Constrained firms produce $q_i^c = a\bar{k}_i^{\beta} < q^c$, whereas unconstrained firms, if there are any, produce exactly q^c. Just as before, no results emerge on firm entry or exit. Table 3 shows two examples where entry occurs following financial liberalization.

We can show that the common markup charged by firms under financial liberalization is below the markup charged by any good 1 producer in the absence of financial markets. Thus, financial liberalization reduces price-cost margins here too. One immediate implication of this finding is the reduction in the Lerner index brought about by financial liberalization. Moreover, in the high wealth equilibrium, we can also show that concentration declines: the largest firms, those that remain unconstrained even without financial markets, see their market share decline once financial liberalization is introduced. In the low wealth case, where all firms are financially constrained in the absence of those markets, the distribution of firms sizes mimics the distribution of wealth. Thus, although the wealthiest firms will produce the largest quantities in the absence of financial markets, how their market shares under financial constraints compare with the common market share of all good 1 producers under financial liberalization is not clear without further assumptions.

We summarize our results in the Proposition below (with proof in the appendix).

Proposition 4 *Under homogenous ability and heterogeneous wealth, the common markup charged by good 1 producers in the presence of financial markets is lower than the markup charged by any good 1 producer in the absence of those markets; the introduction of financial markets causes the Lerner index to decline; if financial constraints are not binding for the larger firms, concentration declines following financial liberalization.*

Heterogeneity in wealth captures two important features of the data, namely the

reduction in concentration (when financial constraints do not bind for the larger firms) and in the Lerner index. We interpret these results as indicating that the presence of wealth differences is the most important driving force of the changes in product market competition associated with financial liberalization. In the absence of other forms of firm heterogeneity, however, the model predicts a degenerate distribution of firm sizes under financial liberalization. A meaningful distribution of firms sizes follows if differences in ability are also incorporated in the model. We thus proceed to simulate a final environment where both ability and wealth are heterogeneous.

In order to be maintain the important feature that financial constraints are binding mostly for small firms and potential entrants, we posit a positive correlation between ability and wealth. Since the more able will also be the largest producers, if these very able firms were able to attain their optimal scale of production even without financial constraints, we would expect to find the same reduction in concentration and in the Lerner index as before. We tackle this scenario in the next section.

3.4 Heterogeneity in both ability and wealth

Positive correlation of wealth and ability We capture the positive correlation between ability and wealth by allowing for two levels of initial wealth: a low one for agents of low and medium ability; and a high one for agents of high ability. For reasons discussed above, and without loss of generality, we assume that the level of wealth of the able individuals is sufficiently high to allow them to achieve their optimal scale of production without any resort to external funds. It should be kept in mind that the important assumption here is that it is the large, most able firms that are less sensitive to the tightness of the financial constraints.

Figure 4 depicts the equilibrium with and without financial constraints. The properties of the equilibrium can be derived using the results from the previous section. The elimination of financial constraints now helps more the constrained firms as well as the new firms because the large firms have already attained their optimal scale of production and cannot profit directly from financial deepening.

Table 4 reports the results obtained by solving numerically a typical parametrization

of the model.[13] The main patterns obtained are as follows:

(a) There is firm entry. (b). The previously constrained firms as well as the new entrants gain market share at the expense of the larger firms. (c) Concentration decreases.[14] (d) Average firm size decreases (see 5). (e) Markups (the Lerner index) decrease. The last result is due to the fact that all incumbent firms lower their markups when the constraints are lifted: the constrained due to the fact that they now face lower prices and higher marginal costs, and the unconstrained due to the fact that they lose market share; and the new entrants have lower market shares and hence lower markups than the incumbent.

The model is thus capable of generating patterns that mimic those documented in the empirical literature. It also has additional implications which we discuss briefly below.

Rajan and Zingales (1998) decompose industry growth into growth in the number of establishments and growth in the average size of existing establishments. They state that their "... estimates suggest that financial development has almost twice the economic effect on the growth of the number of establishments as it has on growth of the average size of establishments. As can be seen in figure 5, our model is capable of delivering this result too.

Tybout (2000) discusses the size distribution of firms as a function of economic development. Consistent with the empirical evidence our model predicts that firms in poorer countries will have a smaller scale of operation because financial constraints are likely to be more prevalent in poor countries.

Finally, the relationship between the level of economic development and the degree of competition in product markets has received quite a bit of attention in the literature. While the empirical evidence is scant and inconclusive[15], there exists a strong

[13]The purpose of this table is to establish that the model can give rise to such patterns when ability and wealth are positively correlated. Naturally, there exist alternative parametrizations of the model that do not give rise to these patterns.

[14]Here we refer to commonly used indexes such as $H_j, j = 1, ..4$. The existence of a sufficiently large number of firms with similar ability levels can always guarantee this outcome.

[15]See, for instance, Glen and Singh (2004) who use persistence of profitability measures to argue that LDCs may not have less competitive markets as presumed; or, Tybout (2000) who argues that there are no reliable findings -due to data and conceptual problems- regarding the relationship between the

presumption that developed countries have more competitive product markets than less developed economies. This is typically attributed to government-imposed as well as other barriers to entry. Our model is consistent with this presumption. It has the implication that, for a similar distribution of ability across countries and for a common world price of the financially dependent good, poor, financially constrained countries will have less competitive markets than richer, less financially constrained countries[16].

3.5 Interpretation of changes in price to marginal cost indicators

In some of the environments discussed in this section, we could not sign the changes in the Lerner index. This was often due to compositional effects, as in the heterogeneous ability case: the firms that were forced to leave the market following the introduction of financial markets previously had the lowest markups. But, more generally, would an increase in the Lerner index stand for something a regulator should worry about? In fact, our model could likely generate environments where the Lerner index *increased* following financial liberalization. This could be the case if there were a large mass of very able but also very poor producers which were excluded from market 1 due to lack of capital but which could enter upon liberalization. In fact, it follows immediately from the firm's first-order condition, equation (6), that more able firms optimally produce larger quantities at a lower marginal cost compared to less able ones. Since the equilibrium price is the same for all good 1 producers, it also follows that the more able firms have higher markups than the less able.

More generally, in the simple text-book Cournot duopoly model, one can easily show that firms with lower marginal costs charge higher markups. This is because they have a low marginal cost compared to competitors with higher marginal costs. And that, in this simple duopoly model, replacing one producer with another having lower marginal costs results in an increment of total output, a decline in the price, a decline in output by the incumbent competitor, and in an *increase* in the Lerner index. Again, should a

level of economic development and the degree of competition in goods markets.

[16]This is due to the fact that, for $\bar{k}_1 < \bar{k}_2$ and for a given ability a, $p/MC(q(\bar{k}_1) > p/MC(q(\bar{k}_2)$.

regulator worry about this? Is the consumer worse off?

The consumer unambiguously benefits from the lower price: consumer surplus increases. So how can average markups increase? The entry of more efficient producers which replace less able ones allows the former to charge a higher markup despite the lower price because they are able to produce at a much lower marginal cost. It is not that the price has increased, it is the fact that – by production being carried out by the more efficient producers – the marginal cost of production has declined relative to the new – and lower – price. Of course the existence of higher price-cost margins still leaves room for the regulator to intervene. But the word of caution to be read here is that, the transition from a financially constrained economy to one where financial markets are healthy – absent other regulatory measures – might involve an increase in price to cost margins, which, in itself, is not to be seen as a failure of financial markets. The same applies to concentration indexes or to average firm size: even if these indicators move in a direction contrary to competitiveness, *other things the same*, this is the consequence of production being disproportionately placed in the hands of the most able firms, firms that are able to take greater advantage of their competitive environment despite simultaneously generating overall gains in efficiency. And, as such, increments in concentration, say, or a smaller number of firms – despite potentially indicating a reduction in competitiveness – do not fully eliminate the efficiency gains experienced in formerly financially dependent sectors.

We emphasize again that financial development in our model is always better, from a consumer's point of view, than financial repression: as Proposition 1 shows, the price of good 1 declines and more of it is produced. Stated differently, well-functioning financial markets allow the economy's production possibilities' frontier to expand and, with it, the utility of the representative consumer. Even if average price-cost margins increase, it will be despite the added efficiency in production that financial markets bring about.

4 Additional considerations

More General Distribution of Wealth In addition to allowing for correlation between ability and wealth, another possible extension might be to have the agents be distributed over a two dimensional plane. That is, individuals of different levels of wealth may share the same level of ability. The main interesting implication that arises in such an environment is that the imposition of financial constraints may now trigger both entry and exit in market 1. The new entrants will be those entrepreneurs whose ability a is such that $a \in [\tilde{a}^c, \tilde{a}^u]$, and whose wealth places them above the $k_{\min}(\cdot)$ schedule. The firms exiting the market, have ability levels above $\tilde{a}^u$, and wealth levels below the $k_{\min}(\cdot)$ schedule. These are very able but poor entrepreneurs, who need to borrow in order to be in sector 1. Without further assumptions, one cannot unambiguously determine the net effect on the number of firms or average markups.

Political Economy Considerations The model can be used to study the political economy of financial liberalization/development. Which groups in the population would favor and which ones would oppose liberalization?

In general, in the financially constrained economy there are three groups: Two in sector 1, namely financially unconstrained and financially constrained firms; and the remainder in sector 2. Following financial liberalization, some firms from sector 1 (constrained and unconstrained) will exit while some firms from sector 2 will enter sector 1. The welfare of some of these groups can be unambiguously signed. For instance, those who remain in sector 2 as well as those who leave sector 2 and enter sector 1 are better off. The former because the purchasing power of their output, A, increases due to the lower p. And the latter because they can always do at least as well as the former group by opting to stay in sector 2. For the other groups, the situation is more nuanced because, even if he change in the level of profits could be signed, the implications for consumption and utility are harder to derive. Nonetheless, an interesting implication of our analysis is that incumbency does not necessarily imply opposition to liberalization. One of the reasons for this is that some of the incumbent firms may be financially con-

strained and hence unable to achieve their optimal scale of production. Consequently, it is to be expected that the firms operating in sector 1 may not speak with a single voice on issues of financial liberalization, while firms (or individuals) outside the sector may have more homogeneous views and in all likelihood favor financial liberalization.

5 Conclusion

The effects of improvement in the functioning of asset markets (financial development, liberalization, deepening...) on the allocation of resources, economic growth and welfare have been extensively studied in the literature. There is one aspect, though, that has received scant attention in spite of the commonly held view that it is of great importance for economic performance and welfare. This is the relationship between finance and competition in product markets.

In this paper we have taken a first step in characterizing the effects of financial constraints on competition. We have used a general equilibrium model with heterogeneity in ability and wealth (and hence in the degree to which financial constraints may bind). Under the assumption that ability and wealth are positively related, the model has the implication that it is mostly small firms that are constrained in their ability to operate in financially dependent industries. With this specification, the model has properties that are consistent with the existing empirical evidence on the effects of improvements in capital (and banking) markets. In particular, it predicts that the number of firms increases, average size decreases, concentration decreases. And it can also generate output growth in the financially dependent sectors that comes mostly from new entrants rather than from the expansion of existing firms. This specification also has the important implication that average markups unambiguously decline (as measured by the Lerner index), which means that competition in product markets increases. This adds another item to the long list of benefits attributed to financial development.

The model can also be used to discuss the relationship between the level of development and the size distribution of firms and the degree of competition in product markets. For a given distribution of wealth, poorer countries are likely to have smaller firms and

also less competitive markets than richer countries. They are also more likely to benefit from further advancements in financial markets.

The analysis has been carried out in a framework that has been restricted in order to make it feasible to study such a complicated issue. For instance, the nature of the financial constraints has not been modeled. They correspond more closely to unspecified costs of asset trade than to the elaborate agency problems typically discussed in the literature; dynamics have been abstracted from; and so on. Consequently, there is a number of demanding but important extensions awaiting. One could involve the incorporation of dynamics, so that both the cross section and time series properties of the distribution of firms in financially dependent sectors could be derived. Another might involve making financial constraints endogenous.

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6 Appendix

Proposition 1: *The financially unconstrained economy has a lower relative price and a higher quantity of the financially dependent good.*

Proof. Let us remove the financial constraints and hold p fixed. Borrowed capital now allows the –previously– financially constrained firms to expand output. The output of the financially unconstrained firms (if there are any) will also increase due to equation (6). The increased use of good 1 as capital in sector 1 implies a lower production of good 2. Consequently, the production of good 1 relative to that of good 2 increases as well. Compared to the equilibrium prevailing before the removal of the financial constraints, there is now an excess supply of good 1 relative to that of good 2. In order for equilibrium to be restored p must decrease.

Could Q_1 end up being lower in the unconstrained equilibrium? Given that a lower p requires C_1/C_2 to increase, this would require a decrease in C_2. But C_2 can decrease only if either more of good 2 is used as capital in sector 1 or (and) if fewer agents operate in sector 2. In either case, that implies a higher $C_1(Q_1)$. ■

Proposition 2: *If financial constraints bind only for the large firms, then the amelioration of financial constraints results in firm exit from sector 1:* $\tilde{a}^c > \tilde{a}^u$.

Proof. Consider Figure 2. A move from the *unconstrained* to the constrained economy results in a downward shift in the $k_{\min}$ schedule due to $p^c > p^u$ (see equation (9)). The shift in the k^* is ambiguous as the higher p and lower Q_1 pull in opposite directions (equation (7)). Do these two curves intersect to the left or the right of $\tilde{a}^u$? Intersection at a value $a > \tilde{a}^u$ would require that the optimal quantities produced by sector 1 firms decline after financial constraints are introduced (so that the k_{min} and the k^* schedules would intercept to the right of $\tilde{a}^u$). Therefore, q^* decreases as well, and so does the demand for capital as an input, K^*. In turn, this implies an increase in C_2, both because there are more firms operating in sector 2 and there is less demand for good 2 as an input. From equation (2.1), it follows that aggregate income I must also increase.

Recall the first-order condition of sector 1 firms,

$$p(1 - \frac{q_i}{Q_1}) = MC(q_i). \tag{22}$$

Using equation (3), we may rewrite the left-hand side of the first-order condition as:

$$\frac{1}{Q_1}\frac{I}{1+\gamma}(1 - \frac{q_i}{Q_1}). \tag{23}$$

Taking the derivative of the previous expression with respect to Q_1, we find that it increases as a consequence of the reduction in sector 1 output. But since q_i^* decreased, for the first-order condition to be restored at a lower optimal quantity q_i^*, it must be the case that I also declined. But this contradicts the earlier finding that I increased from the assumption that $\tilde{a}^c > \tilde{a}^u$. Therefore, the curves must intersect to the left of $\tilde{a}^u$. Let $\tilde{a}^c$ and $\tilde{k}^c$ denote the values of a and k at this intersection. In a high wealth economy $\bar{k} > \tilde{k}^c$ and thus all $a \in [\tilde{a}^c, \tilde{a}^u)$ enter. ■

Proposition 3: *The elimination of the financial constraints leads to higher market concentration but has an ambiguous effect on the Lerner index.*

Proof. We first consider the case when financial constraints bind only for the large firms. The scale of output is a positive function of ability. Thus, the elimination of financial constraints results in a disproportionate increase in the output of the largest firms as these were previously constrained. The market shares of these firms increase, increasing concentration. When the optimal output of good 1 producers expands following financial liberalization, $q^u \geq q^c$, the group of firms that were financially constrained gain market share following financial liberalization. In this case, we know that, if j is the ability index of the smallest firm that was constrained previous to liberalization, $H_j^u > H_j^c$. When the optimal output of good 1 producers declines following financial liberalization, $q^u < q^c$, let j denote the index of the firm whose output under financial liberalization equals its formerly constrained output level. That is, firm j produces the same output before and after financial liberalization, and firms larger than j expand their output following liberalization. Then, all firms $i \geq j$ gain market share as their output expands and that of all other remaining firms declines. This shows that $H_j^c > H_j^u$.

What about the effect on markups? Let us analyze first the case with partially binding financial constraints. There are two types of firms present after the lifting of financial constraints. Incumbent firms that were constrained before. And incumbent firms that were unconstrained before. The former now have lower markups because they face a lower price and a higher marginal cost (they produce more). The latter also have lower markups because their market share has decreased, see equation (6) (recall that the market share of the previously constrained firms goes up). However, there is a third group of firms, consisting of those that exited. The members of this group used to have lower markups than the other two groups. Therefore, without further assumptions we cannot compare the value of the Lerner index across the two financial environments.

Let us now turn to the case where the constraints bind for all firms. Recall that we only address the case of firm exit. The firms that remain following the lifting of the constraints (those with the highest ability) now charge lower markups than before (due to the lower price and higher marginal cost). However, their markups when financially constrained were the highest (due to lower marginal cost). Thus, the effect on the Lerner concentration index is ambiguous. Since all firms increase production following liberalization, but the more able do so disproportionately more, it follows that the market share of the more able will increase. This shows that there exists $j \geq 1$ for which $H_j^u > H_j^c$. ■

Proposition 4: *Under homogenous ability and heterogeneous wealth, the common markup charged by good 1 producers in the presence of financial markets is lower than the markup charged by any good 1 producer in the absence of those markets; the introduction of financial markets causes the Lerner index to decline; if financial constraints are not binding for the larger firms, concentration declines following financial liberalization.*

Proof. Without loss of generality, we assume that good 1 producers always include the wealthiest individuals in the economy. While the identity of those producers is immaterial in the presence of financial markets (since anyone could borrow to attain the common optimal scale of production), under financial constraints the rich have an obvious advantage and might be able to produce good 1 when less wealthy individu-

als would not. Assuming that the rich will always participate in good 1 production simplifies comparisons across the cases with and without financial markets. There are three potential types of agents in the financially constrained environment: unconstrained producers, constrained producers and new entrants (firms that enter market 1 when financial markets are eliminated). Recall that, under the constrained environment, the price of good 1 increases and total output in this market declines. Since all good 1 producers have identical ability, their optimal markup and output is also identical; they will produce different quantities to the extent that financial constraints bind. Consider the unconstrained firms, the wealthiest of all. It follows from the first-order condition with respect to firm i's quantity, equation (6), that an unconstrained firm's market share must increase if p increases and Q_1 declines. Thus, when financial constraints are not binding for the large firms, their market shares are greatest under financial constraints and concentration decreases following financial liberalization. In turn, this immediately implies that the markup charged by unconstrained firms in the absence of financial markets exceeds that charged in the environment without financial constraints. Constrained firms produce as much as their wealth holdings allow them to. New entrants (relative to the case with financial markets), if there are any, will be even smaller firms which will also be financially constrained. The group of financially constrained firms cannot raise their output to the optimal level. Because they all face a common market price p^c and have identical marginal cost curves (since ability is constant), it follows that the markup of firms in this group is necessarily above that of unconstrained firms. This establishes the fact that all firms in the financially constrained environment charge strictly higher markups than the common markup prevailing in the unconstrained case. Since

$$\frac{p^c}{MC_i(q_i^c)} > \frac{p^u}{MC_j(q_j^u)}, \tag{24}$$

where i and j stand for good 1 producers in the constrained and unconstrained environments, respectively, this implies that:

$$\mu_i = \frac{p^c - MC_i(q_i)}{p^c} > \mu_j = \frac{p^u - MC_j(q_j)}{p^u}. \tag{25}$$

Since the Lerner index is a market share weighted average over the μ_i and μ_j terms, this immediately implies a reduction in that index following financial liberalization. ■

Table 1: Removing the financial constraints: Homogeneous ability and wealth

N	n	K	Q_1	Q_2	p	σ	H_4
Constrained Economy							
50.0000	25.0000	25.0000	250.0000	15.0000	0.1600	0.2188	0.1600
Unconstrained Economy							
50.0000	16.0000	30.1714	265.7668	20.4000	0.1514	0.0625	0.2500

Note: $a(i) = 10$, $\bar{k}(i) = 1$, $\beta = 0.8$, $A = 0.6$, $\gamma = 1$.
N = number of agents, n = number of firms, K = capital input, Q_1 = output in sector 1, Q_2 = output in sector 2, p = relative price, σ = Lerner index, H_4 = share of 4 largest firms.

Table 2: Removing the financial constraints: Heterogeneous ability, homogeneous wealth

N	n	K	Q_1	Q_2	p	σ	H_4
Large firms are constrained, $k = 3$							
50.0000	22.0000	65.1946	428.6091	16.8000	0.2371	0.1979	0.2181
Unconstrained Economy, $\bar{k} = 3$							
50.0000	16.0000	72.6681	470.7752	20.4000	0.2076	0.0706	0.3756
All firms are constrained, $\bar{k} = 1$							
50.0000	22.0000	22.0000	179.4147	16.8000	0.2497	0.3865	0.2163
Unconstrained Economy, $\bar{k} = 1$							
50.0000	11.0000	30.8138	228.7439	23.4000	0.1862	0.0955	0.4566

Note: $a(1) = 10$,$a(i) = 0.98 * a(i-1), i = 1, ..N$, $\bar{k}(i) = 1$, $\beta = 0.8$, $A = 0.6$, $\gamma = 1$.
N = number of agents, n = number of firms, K = capital input, Q_1 = output in sector 1, Q_2 = output in sector 2, p = relative price, σ = Lerner index, H_4 = share of 4 largest firms.

Table 3: Removing the financial constraints: Homogeneous ability, heterogenous wealth

N	n	K	Q_1	Q_2	p	σ	H_4
High average wealth, large dispersion $\bar{k} = \{3, 0.0001\}$							
Financially Constrained Economy							
50.0000	10.0000	18.9365	146.6829	24.0000	0.2391	0.1000	0.4000
Financially Unconstrained Economy							
50.0000	21.0000	17.2378	186.5422	17.4000	0.1617	0.0476	0.1905
Low average wealth, low dispersion $\bar{k} = \{1, 0.0001\}$							
Financially Constrained Economy							
50.0000	10.0000	10.0000	100.0000	24.0000	0.2400	0.3057	0.4000
Financially Unconstrained Economy							
50.0000	14.0000	11.3079	123.1627	21.6000	0.1648	0.0714	0.2857

Note: $a(1) = 10$,$a(i) = 0.98 * a(i-1), i = 1, ..N$, $\bar{k}(i) = 3$ for $i = 1, ..10$, $\bar{k}(i) = 0.0001$ for $i = 11, ..50$ in the high average wealth, high dispersion economy and $\bar{k}(i) = 1$ for $i = 1, ..10$, $\bar{k}(i) = 0.0001$ for $i = 11, ..50$, in the low average wealth, low dispersion economy, $\beta = 0.6$, $A = 0.6$, $\gamma = 1$.
N = number of agents, n = number of firms, K = capital input, Q_1 = output in sector 1, Q_2 = output in sector 2, p = relative price, σ = Lerner index, H_4 = share of 4 largest firms.

Table 4: Removing the financial constraints: Heterogeneous ability and wealth

N	n	K	Q_1	Q_2	p	σ	H_4
High average wealth, high dispersion $\bar{k} = \{3, 0.0001\}$							
Constrained Economy							
50.0000	10.0000	18.9154	134.3907	24.0000	0.2611	0.1015	0.4524
Unconstrained Economy							
50.0000	15.0000	18.2769	147.9632	21.0000	0.2212	0.0692	0.3362
Low average wealth, low dispersion $\bar{k} = \{1, 0.0001\}$							
Financially Constrained Economy							
50.0000	10.0000	10.0000	91.4636	24.0000	0.2624	0.3057	0.4244
Financially Unconstrained Economy							
50.0000	11.0000	11.7750	104.0906	23.4000	0.2078	0.0927	0.4203

Note: $a(1) = 10$,$a(i) = 0.98 * a(i-1), i = 1, ..N$, $a(1) = 10$,$a(i) = 0.98 * a(i-1), i = 1, ..N$, $\bar{k}(i) = 3$ for $i = 1, ..10$, $\bar{k}(i) = 0.0001$ for $i = 11, ..50$ in the high average wealth, high dispersion economy and $\bar{k}(i) = 1$ for $i = 1, ..10$, $\bar{k}(i) = 0.0001$ for $i = 11, ..50$, in the low average wealth, low dispersion economy, $\beta = 0.6$, $A = 0.6$, $\gamma = 1$.
N = number of agents, n = number of firms, K = capital input, Q_1 = output in sector 1, Q_2 = output in sector 2, p = relative price, σ = Lerner index, H_4 = share of 4 largest firms.

Figure 1: Equilibrium in the financially unconstrained economy

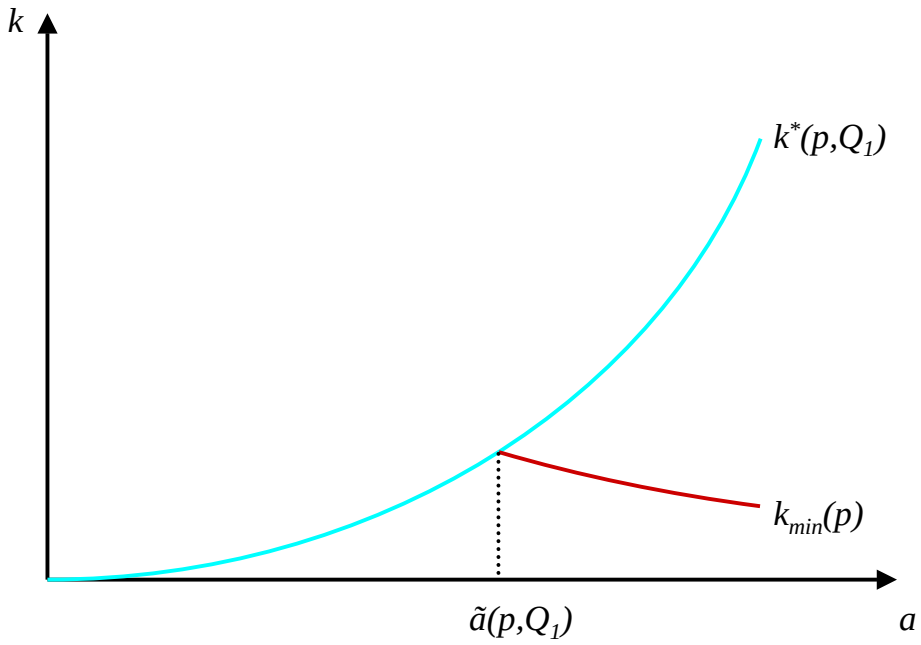

Figure 2: Equilibrium when large firms are financially constrained

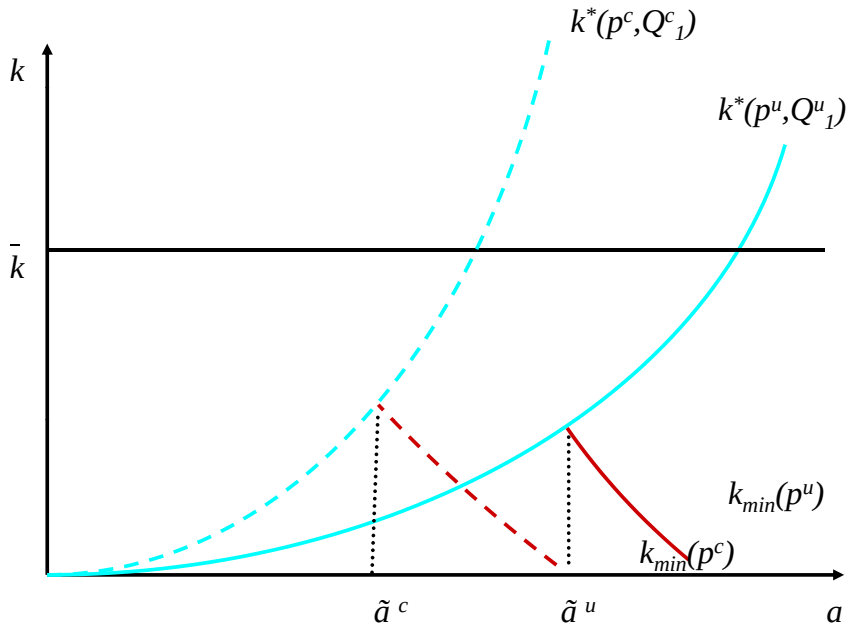

Figure 3: Equilibrium when all firms are financially constrained

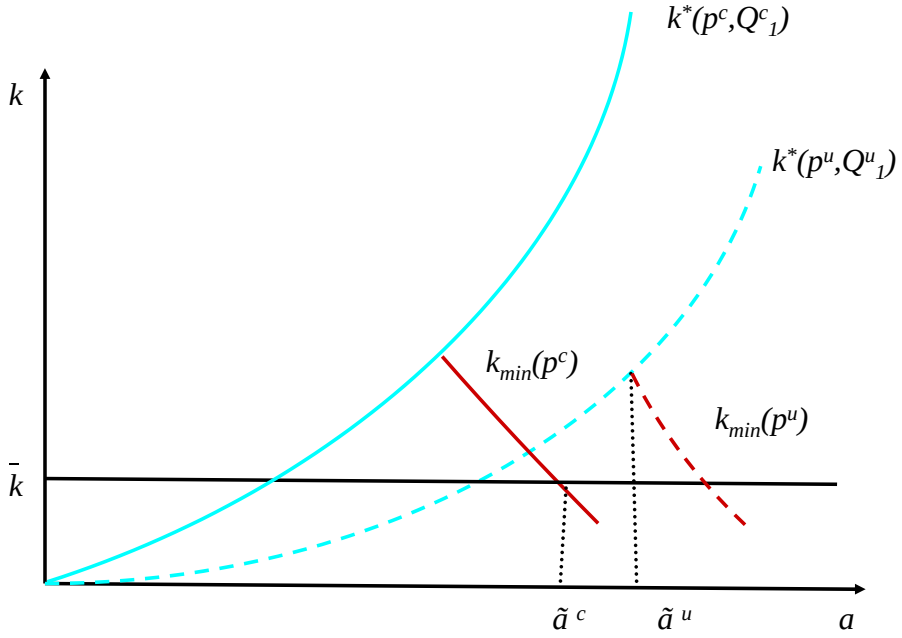

Figure 4: Equilibrium in the case of positive correlation of ability and wealth

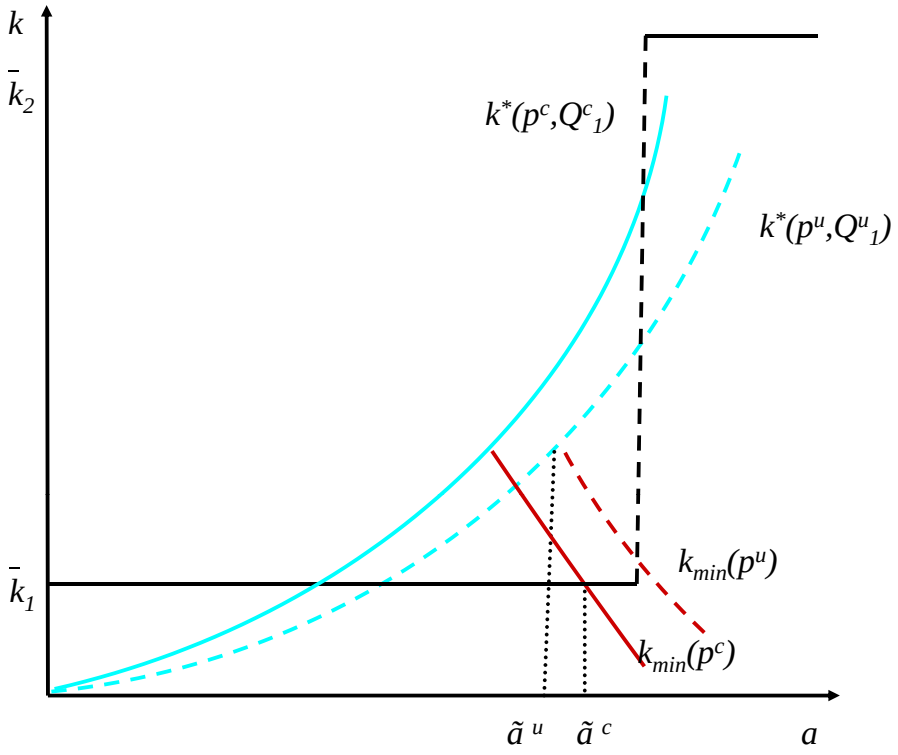

Figure 5: The distribution of capital and output across firms