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ABSTRACT

Capital Markets, Information Aggregation and Inequality: Theory and Experimental Evidence*

In most industrialized economies, financial wealth is distributed far more unequally than income. According to Wolff (2007) more than half of the American households possess almost no productive capital while realizing about 20 percent of national income. This mismatch poses a problem for the efficient aggregation of consumer needs on capital markets. Individuals use information about their own preferences as consumers to identify profitable investments. Under certain conditions, this behaviour efficiently matches future demand with productive capacity, thus replacing future markets for consumer goods. However, when wealth is distributed too unequally, capacity cannot match consumer needs. I present some first experimental evidence in favour of consumption driven investment behaviour based on real portfolio choices and self-reported preferences about consumer goods.

JEL Classification: C91, G11, G14 and O16
Keywords: capital markets, consumption driven investment, information aggregation and wealth distribution

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1 Introduction

In most industrialized economies, wealth is distributed far more unequally than income. According to Wolff (2007) 60 percent of the American households possess almost no financial wealth (one percent of total financial wealth), while the top five percent of households hold more than two thirds of financial wealth. Compared to this, income inequality is much lower. The poorest sixty percent of US households realize about 22 percent of total income. A similar disparity of income and wealth distributions can be observed in many other countries (Davies et al. 2007). In the present paper, I argue that this mismatch may pose a problem for the proper functioning of the capital market as an information aggregation device.

It is one of the fundamental insights of financial market theory, that capital markets may efficiently aggregate decentralized information about asset returns. The aggregation of information through the capital market is particularly useful when the development of new products or technologies needs to be financed. The potential demand for new products is the aggregate of dispersed and private information. Moreover, forward markets for new goods are often unavailable. In the present paper I argue that capital markets may replace such forward markets and make productive capacities react to dispersed information about individual needs. Under certain conditions, they can even efficiently aggregate information about consumer preferences.

The mechanism at work is the following. Under aggregate demand uncertainty rational investors use information about their own preferences (as consumers) for their portfolio decisions. They buy stocks of companies which they consider to be profitable in the future. Privately observed preferences are a signal of aggregate future demand. Hence, consumers who care about the product of a company have a reason to believe that this company will also attract other customers in the future. They invest in the production of goods that they would be willing to buy themselves. Accordingly, capital markets do not only aggregate second order beliefs about the future demand of other customers, but also first order information about individual investors' preferences. Consumption driven investment directs wealth towards companies that are likely to find many customers. Under certain conditions, this mechanism efficiently replaces missing forward markets.

Another main result of this paper is that wealth inequality and credit constraints are detrimental to this information aggregation process. When only a subgroup of individuals owns significant amounts of wealth, investment decisions are distorted towards their particular needs. This leads to a misallocations on capital markets when the distribution of current wealth and future income do not match.

The theoretical analysis of this paper is based on a Bayesian capital market game. Consumers hold some initial wealth which they can invest at the given riskless rate on the capital market. A company with a new product looks for financing on the capital market. It collects investments and promises to return investors their share of future profits. There is aggregate uncertainty whether consumers like the new product. Each consumer uses his private information about his own preferences and updates his belief about aggregate demand. Individual investment behavior depends on the observed private signal. When wealth is distributed equally enough, the aggregate capacity increases with aggregate demand. Instead, when wealth is distributed unequally, investment decisions depend on individual signals of the richest consumers in the population. This may lead to a mismatch of production and consumption.

The empirical part of this paper provides some first experimental evidence in favor of consumption driven investment behavior. I study the portfolio choice of students in a stock market experiment. Subjects were asked to compose a portfolio that consist of the stocks in the DAX30 and Euro Stoxx 50 indices. They were rewarded proportionally to the increase of the value of their portfolio over a period of eleven weeks. After making their portfolio choice individuals had to answer several questions regarding their knowledge of and their preference for the selected companies' products.

The collected data clearly speaks in favor of the hypothesis that individuals invest in companies whose products they like. An overwhelming majority of investors (95 percent) likes the products of the companies in which they invest. This is not a straightforward outcome. Generally, subjects should care about the potential demand for the products of a company. However this potential demand does not need to be correlated with the personal likes or dislikes of single individuals. Nevertheless, in about seventy percent of the transactions subjects stated that they could imagine buying their companies' products themselves.

We also asked subjects whether or not they prefer the goods of their companies to those of competing companies. In more than one third of the cases, competitors receive less support from investors than the company in which the subject has invested. Finally, we compared the stated preferences of shareholders and other subjects of some selected shares. It turns out that shareholders clearly have a stronger preference for their companies' products than other agents.

The present paper is related to a huge literature that studies the effects of wealth inequality on allocative efficiency and in particular on the functioning of capital markets. A non exclusive list is Aghion and Bolton (1997), Banerjee and Newman (1993), De Meza and Webb (1992), Galor and Zeira (1993), Grüner (2003), Grüner and Schils (2007), and

Piketty (1997). All these papers emphasize the link between credit market imperfections and agents' investments into private production possibilities. Investors with too little wealth either do not get credit for their individual investment projects or they only get credit at a higher interest rate. This is why the distribution of wealth has macroeconomic implications. The present paper instead considers the link between inequality and the investment in publicly held companies.

Other models that also analyzes the direction of technological change can be found in Funk (1993 and 1996). Technological change is modelled as a sequence of competitive periods connected via monopolistically competitive transition periods. Consumers base their expectations about future returns of technologies on past and present data about the economy. Under some assumptions, the long-run direction of change is always efficient. The present paper, instead, considers the correlation between aggregate demand and private preferences as a main driver of investment decisions. Funk (1998) has a model in which long run investments adjust to the needs of the rich. However, this is due to the fact that these investments are indeed the most profitable ones.

Finally, the empirical part of this paper is related to recent evidence that many individuals make their investment decisions based on available (regional) information (such as e.g. Coval and Moskowitz, 1999). In contrast to this research the present paper focuses on information of investors about their own consumption needs.

2 The model

2.1 Agents and endowments

The economy is populated by an infinite number of consumer-investors indexed by $i \in [0,1]$. Each consumer has an initial endowment of wealth w_i in period 1 and receives an exogenous income y_i in period 2. Income and wealth are measured in monetary units. Individuals consume in period 2 and use the capital market to increase their income in the second period. They can invest any positive amount of money at the riskless rate R, i.e. one unit invested in period 1 turns into R units in period 2. The riskless rate R is exogenously given. In period 2, two consumption goods are available: consumption c (at a price of 1) and the consumption good produced by a new company x. Consumers have private information about their preferences for the new good. Preferences are represented by the following utility function:

$$u\left(c_i, x_i, \theta_i\right) = c_i + \theta_i x_i^{\alpha}, \tag{1}$$

where $0 < \alpha < 1$. The parameter θ_i is private information of agent i. It may assume two values, 0 and 1, i.e. agents either care about good x, or they do not.

There is a spot market for goods c and x in period 2. But there is neither a forward market for good x, nor a credit market on which agents may borrow against future income y_i.[1,2]

2.2 Aggregate risk

There is aggregate risk regarding the share of agents who would like to consume good x in the future. The share of agents s who would like to consume this good is distributed according to

$$s := \int_{i=0}^{1} \theta_i di = \begin{cases} \beta > 1/2 & \text{with probability } 1/2 \\ 1-\beta & \text{with probability } 1/2 \end{cases}. \tag{2}$$

Observing his private signal $\theta_i = 1$ an agent updates his beliefs that state $s = \beta$ has occurred. The corresponding probability is

$$p\left(s = \beta \,|\theta_i = 1\right) = \frac{\frac{1}{2}\beta}{\frac{1}{2}\beta + \frac{1}{2}\left(1-\beta\right)} = \beta. \tag{3}$$

2.3 The Bayesian investment game

There are $m > 1$ firms which have access to a technology for the production of good x. Each firm produces according to the linear technology:

$$x = \tilde{x}, \tag{4}$$

where x denotes the output of the good produced and $\tilde{x}$ the investments made in period 1 (hereafter also called capacity). One unit of initial wealth can be turned into one unit of capacity.[3] Investors may choose to invest any amount $\tilde{x}_i$ in these companies and the total size of all companies is determined by the investments of all agents

[1] Both assumptions are key. With a future market, companies could finance investments drawing on the revenues on the future market. On a credit market, consumers could borrow against future income in order to finance an investment in their preferred technology. Assuming away the future market is realistic, when good x is an innovation that is not contractable at date 1. Asuming away credit markets is justified, when there is a sufficiently severe moral hazard problem involved in borrowing.

[2] See Banerjee and Newman (1993) and Galor and Zeira (1993) for elegant ways of modelling a premium on interest rates under moral hazard.

[3] The robustness of the main result for arbitrary technologies is discussed in the conclusion of this paper.

$$\tilde{x} = \int_{i=0}^{1} \tilde{x}_i di. \tag{5}$$

All companies act as price takers in period 2 and distribute profits to all shareholders according to the size of their relative shares.

3 Equilibrium

3.1 Equilibrium concept

In period 2, consumers receive their exogenous income y_i and the return on their riskless (at rate R) or risky investments. I define $\tilde{y}_i$ as the total budget available to consumer i in period 2. An equilibrium of this economy is defined as follows.

Definition 1 *An equilibrium of the model consists of*

(i) a consumption plan $x_i(p, \tilde{y}_i)$ for each consumer,

(ii) an investment plan $\tilde{x}_i(\theta_i, w_i)$ for each consumer, and

(iii) a relative price function $p(\tilde{x}, s)$ for good x,

such that

(i) the consumption plan maximizes utility (1) subject to the consumer's period 2 budget constraint,

(ii) the investment plans constitute a Bayesian Nash equilibrium of the investment game, taking into account the consumption plans and the relative price $p(\tilde{x}, s)$, and

(iii) at the price $p(\tilde{x}, s)$, the demand for good x equals productive capacity $\tilde{x}$.

3.2 Equilibrium on the goods market

In period 2, at a given price of the innovation p, an agent maximizes (1) subject to the budget constraint

$$\tilde{y}_i = c_i + px_i. \tag{6}$$

This yields the individual demand for good x

$$x_i = \left(\frac{\alpha\theta_i}{p}\right)^{\frac{1}{1-\alpha}}. \tag{7}$$

From $\theta_i \in \{0,1\}$, individual demand simplifies to

$$x_i = \theta_i \left(\frac{\alpha}{p}\right)^{\frac{1}{1-\alpha}}. \tag{8}$$

Aggregate demand is

$$x = \int_{i=0}^{1} \theta_i di \left(\frac{\alpha}{p}\right)^{\frac{1}{1-\alpha}}, \tag{9}$$

and inverted aggregate demand

$$p = \alpha \left(\int_{i=0}^{1} \theta_i di \frac{1}{x}\right)^{1-\alpha}. \tag{10}$$

At date 2, firms that invested in capacity for the production of x act as price takers on the product market. Hence, aggregate capacity $\tilde{x}$ in equilibrium determines the price according to

$$p = p\left(\tilde{x}, s\right) = \alpha \left(\frac{s}{\tilde{x}}\right)^{1-\alpha}. \tag{11}$$

The equilibrium return on an investment in capacity for the production of good x is

$$r = \frac{p\left(\tilde{x}, s\right)\tilde{x}}{\tilde{x}} = p\left(\tilde{x}, s\right). \tag{12}$$

3.3 Bayesian equilibrium

Consider now a symmetric Bayesian equilibrium of the investment game, where each agent with signal $\theta_i = 1$ invests the same amount $\hat{x}$, whereas the others ($\theta_i = 0$) do not invest. Agents, who invest a positive amount $\hat{x}$ less than w_i must be indifferent between an investment in the innovation and an investment at the risk-free rate R. Therefore, the equilibrium investment $\hat{x}$ of consumers who care about the good is characterized as follows.

$$\begin{aligned}
R &= E_s p\left(s \cdot \hat{x}, s\right) && (13)\\
&= \beta\alpha \left(\frac{\beta}{\beta\hat{x}}\right)^{1-\alpha} + (1-\beta)\,\alpha \left(\frac{1-\beta}{(1-\beta)\,\hat{x}}\right)^{1-\alpha} && (14)\\
&= \alpha\hat{x}^{\alpha-1} && (15)\\
\Leftrightarrow\ \hat{x} &= \left(\frac{\alpha}{R}\right)^{\frac{1}{1-\alpha}}. && (16)
\end{aligned}$$

Hence, the equilibrium capacity is

$$\tilde{x} = \beta \left(\frac{\alpha}{R}\right)^{\frac{1}{1-\alpha}} \tag{17}$$

in state $s = \beta$, and

$$\tilde{x} = (1-\beta) \left(\frac{\alpha}{R}\right)^{\frac{1}{1-\alpha}} \tag{18}$$

otherwise.[4]

3.4 The first best

I can now compare this equilibrium outcome to a planner's solution, assuming that the planner knows the realization of s. An investment in x has an opportunity cost of R units of the consumption good c in period 2. Hence, social welfare is maximized when all individuals consume

$$x_i = \left(\frac{\alpha\theta_i}{R}\right)^{\frac{1}{1-\alpha}}. \tag{19}$$

This is the quantity demanded at a relative price of R. Any deviation of equilibrium prices from this level reduces social welfare. Thus, the equilibrium from the previous subsection maximizes social welfare.

Proposition 1 *When all agents hold wealth $w_i \geq \left(\frac{\alpha}{R}\right)^{\frac{1}{1-\alpha}}$ there is a symmetric investment equilibrium, in which all agents invest an amount $\hat{x} = \left(\frac{\alpha}{R}\right)^{\frac{1}{1-\alpha}}$ in the capacity for the production of good x, if and only if they would like to consume good x themselves ($\theta_i = 1$). This symmetric equilibrium is Pareto-optimal and maximizes Benthamian welfare.*

According to Proposition 1, the Bayesian investment game efficiently replaces a missing forward market for good x. Obviously, this result rests on the assumed linearity of the relationship between productive capacity and output, i.e. there may not be any indivisibilities in the production of good x. In the presence of indivisibilities (e.g. in form of a strictly concave production function), equilibrium capacity would still increase with the share of consumers. However, the resulting equilibrium would generally not be efficient anymore.

[4]Note that the best reply to this symmetric equilibrium strategy is not unique, because consumers are small and do not affect the price for good x. This would be different in a model with finitely many agents. For the same reason there are also mixed strategies equilibria in which the stochastic investments add up to the above values for $\tilde{x}$.

4 Two wealth classes

4.1 Heterogeneity with identical endowments

I now consider an economy with two distinct groups of consumers of equal size. The fraction of consumers who care about good x may differ across groups. The shares s_1 and s_2 of agents who care about good x are independently distributed according to

$$s_1 = 2 \cdot \int_{i=0}^{0.5} \theta_i di = \begin{cases} \beta > 1/2 & \text{with probability } \frac{1}{2} \\ 1-\beta & \text{with probability } \frac{1}{2} \end{cases} \tag{20}$$

$$s_1 = 2 \cdot \int_{i=0.5}^{1} \theta_i di = \begin{cases} \beta > 1/2 & \text{with probability } \frac{1}{2} \\ 1-\beta & \text{with probability } \frac{1}{2} \end{cases} . \tag{21}$$

Consider first a case, in which all agents hold initial wealth $w_i \geq \left(\frac{\alpha}{R}\right)^{\frac{1}{1-\alpha}}$. Again, in this case, there is an equilibrium in which all consumers of the innovation coordinate on individually investing $\hat{x}$, if and only if they demand the good themselves. The expected return takes the value R. In case that an agent observes the signal 1, he attaches the following updated probabilities to the vector of states.

s_1, s_2	β	$1-\beta$
β	$\frac{\beta}{2}$	$\frac{1}{4}$
$1-\beta$	$\frac{1}{4}$	$\frac{1-\beta}{2}$

In case that an agent observes the signal 0, the probabilities are

s_1, s_2	β	$1-\beta$
β	$\frac{1-\beta}{2}$	$\frac{1}{4}$
$1-\beta$	$\frac{1}{4}$	$\frac{\beta}{2}$

The equilibrium investment $\hat{x}$ of investors, who care about the good, is characterized by

$$R = E_s p\left(s \cdot \hat{x}\right) \tag{22}$$

$$= \frac{\beta}{2}\alpha\left(\frac{\beta}{\beta\hat{x}}\right)^{1-\alpha} + \frac{1-\beta}{2}\alpha\left(\frac{1-\beta}{(1-\beta)\hat{x}}\right)^{1-\alpha} + \frac{1}{2}\alpha\left(\frac{\frac{1}{2}}{\frac{1}{2}\hat{x}}\right)^{1-\alpha} \tag{23}$$

$$= \alpha\hat{x}^{\alpha-1}. \tag{24}$$

Assume that all individuals hold enough wealth in order to finance this investment. The equilibrium capacity is

$$\tilde{x} = \begin{cases} \beta \left(\frac{\alpha}{R}\right)^{\frac{1}{1-\alpha}} & \text{if } s_1 = s_2 = \beta \\ (1-\beta) \left(\frac{\alpha}{R}\right)^{\frac{1}{1-\alpha}} & \text{if } s_1 = s_2 = 1-\beta \\ \frac{1}{2} \left(\frac{\alpha}{R}\right)^{\frac{1}{1-\alpha}}. & \text{if } s_1 \neq s_2 \end{cases} \tag{25}$$

Again, the equilibrium is efficient and maximizes social welfare.

4.2 The role of inequality

Suppose now instead that one of the two groups (the poor) does not hold any wealth ($w = 0$) but they have some income $y > 0$ in period 2. The poor cannot borrow against their own future income in order to finance an investment. Therefore, they do not invest on the capital market. Consider an equilibrium, in which only rich agents who observe $\theta_i = 1$, invest an identical amount $\hat{x} > 0$. It is characterized by the following condition on $\hat{x}$.

$$R = E_{s_1,s_2} p\left(s \cdot \hat{x}\right) = \sum_{s_1,s_2} \pi\left(s_1, s_2/\theta_i = 1\right) \cdot \alpha \left(\frac{\frac{s_1+s_2}{2}}{\frac{s_1}{2} \cdot \hat{x}}\right)^{1-\alpha} \tag{26}$$

$$= \frac{\beta}{2}\alpha \left(\frac{\beta}{\frac{\beta}{2}\hat{x}}\right)^{1-\alpha} + \frac{1-\beta}{2}\alpha \left(\frac{1-\beta}{\frac{1-\beta}{2}\hat{x}}\right)^{1-\alpha} + \frac{1}{4}\alpha \left(\frac{\frac{1}{2}}{\frac{\beta}{2}\hat{x}}\right)^{1-\alpha} + \frac{1}{4}\alpha \left(\frac{\frac{1}{2}}{\frac{1-\beta}{2}\hat{x}}\right)^{1-\alpha} \tag{27}$$

$$\Leftrightarrow \quad R = \frac{1}{2}\alpha \left(\frac{1}{2\hat{x}}\right)^{1-\alpha} + \frac{1}{4}\alpha \left(\frac{1}{\beta\hat{x}}\right)^{1-\alpha} + \frac{1}{4}\alpha \left(\frac{1}{(1-\beta)\,\hat{x}}\right)^{1-\alpha} \tag{28}$$

$$\Leftrightarrow \quad R = \frac{1}{4}\left(2 + \frac{1}{\beta^{1-\alpha}} + \frac{1}{(1-\beta)^{1-\alpha}}\right) \alpha \left(\frac{1}{\hat{x}}\right)^{1-\alpha} \tag{29}$$

$$\Leftrightarrow \quad \hat{x} = \left(\frac{1}{4}\left(2 + \frac{1}{\beta^{1-\alpha}} + \frac{1}{(1-\beta)^{1-\alpha}}\right) \frac{\alpha}{R}\right)^{\frac{1}{1-\alpha}}. \tag{30}$$

Consequently, depending on the state of the world, there are only two aggregate investment levels: $\beta\hat{x}$ and $(1-\beta)\,\hat{x}$. Equilibrium investment only depends on the information of the rich. Obviously, the new equilibrium does not maximize social welfare, because it does not take into account the marginal social benefit from an investment in capacity for the production of good x.

Proposition 2 *(i) In the case with two distinct groups of consumers, the capital market equilibrium is efficient, when both groups hold a sufficient amount of initial wealth.*

(ii) When group 1 holds no wealth, while group 2 holds all the wealth, equilibrium capacity only depends on the information of wealthy consumers. Capital market equilibria are not Pareto-optimal.

5 Empirical Evidence

5.1 Experimental setup

The theoretical analysis of this paper rests on the idea that imperfectly informed investors should use information about their own consumption needs, when they buy companies' stocks. In this section, I present some first empirical evidence on this question. The first hypothesis, that I would like to test, is that individuals like the products of the companies they own. The second testable hypothesis is that consumers buy stocks of companies whose products they prefer to the products of direct competitors. A third hypothesis is that shareholders think more positively about their companies' products or an employment with this company than other subjects. One should note that - under full information - none of these relationships is likely to hold. Well informed consumers, who dislike some product A of company B, may well buy company B's stock if they believe that B can make profits with other customers.

In order to test all three hypotheses, we invited students of Mannheim University to participate in the following experiment. Each student was assigned an amount of five Euros, which he or she was supposed to allocate to the stocks of 67 publicly listed companies. The companies are the ones that constitute the German DAX 30 and the Euro Stoxx 50 indices. Each subject was asked to determine the shares (in percent) of the five Euros that he or she allocates to the different stocks. We ran the experiment twice: in a first round with 26 students, in the second larger round with 63 students. In the first round, students had to pick at least 2 and up to 10 companies, in the second one up to five companies. I only report the results of the larger experiment, the results of the smaller experiment are very similar and available upon request.

We announced that the value of each subject's portfolio x would be determined after a period of eight weeks. The second experiment took place on February 27th, 2008 the portfolio will be evaluated on April 25th, 2008. The subjects were told that they obtain the following final pay-off:

$$y = \max\left\{\min\left\{5 + 2\left(x - 5\right), 15\right\}, 5\right\}. \tag{31}$$

Subjects were paid the initial 5 Euros plus twice the increase of the value of their portfolio. We have chosen a lower bound of five Euros, because we did not want to generate deception in the subject pool about losses that may arise during the experiment. The lower bound also facilitated the payment procedure. The minimum payoff of five Euros was paid right after the experiment. For budgetary reasons, there was also an upper bound of

fifteen Euros. It is quite unlikely that any investment yields such a high return in this short period of time. Hence, this bound is unlikely to be relevant for individual decision making.

All subjects were given up to 20 minutes for market research on the internet before they made their investments. After the allocation of the five Euro budget, we asked the subjects to reply to eight questions concerning the stocks which they selected into their portfolio. Among the questions, there was one that asked whether individuals know the products of the respective firm. We also asked whether the subjects like the products and whether they like the products more than those produced by competing firms.

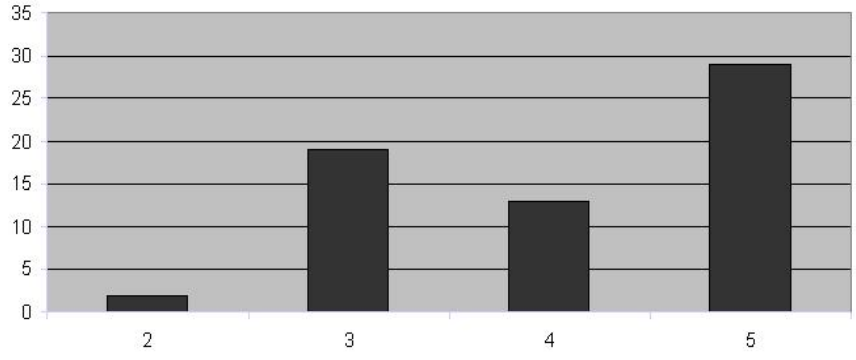
The experimental design was intended to make subjects look for potential winners on the stock market. This is consistent with many answers to our question about subjects' motivation for their decision. Many subjects argued, that they wanted to buy stocks that were likely to perform well over the coming weeks.

The students that participated in our experiment studied economics (38), business (12), law (1), political science (1), psychology (6), languages (2) and computer science (3). One subject did not answer to this category.

5.2 Results

Figure 1 describes the distribution of the size of subjects' portfolios. On average, the 63 students selected 4,1 companies into their portfolio. We collected 258 statements about motivations for individual investments in one of the companies. Table 1 ranks the 67 companies according to the aggregate size of the investments. It also reports the number of investors who have chosen this particular company. The Table clearly shows that there is a "home bias" in the sense that European non-German companies (EU), that are less well known to the German students, end up at the lower end of the Table.

Figure 1: The distribution of the size of subjects' portfolios



It is interesting that most students picked diversified portfolios, because the lower bound of five Euros could actually make subjects look for the most risky single investment.

According to Table 1 and according to the self-reported motivations, this reasoning has not played any role at all.[5]

As can be seen in Table 5, an overwhelming majority of investors likes the products of their companies. Out of the 258 statements about the preference for companies' goods 95 percent (191) were affirmative (Table 5). There were only 11 cases, in which a student invested in a company whose product he or she did not really like. Answers to the other question about the motivation of choices also reveal that the hypothesis of consumption based investment is compatible with the data. In about 67 percent (171) of the transactions, subjects say that they are familiar with the companies' products (Table 2). More importantly, in about 73 percent of the cases, subjects could imagine to buy the companies' products themselves (Table 3).

Many of the 67 companies from our sample produce goods that are not direct consumer goods. Not surprisingly, they receive lower investments on average. The bias towards consumer goods which is also reflected in Table 1.

Subjects clearly tend to choose companies whose products they like. Moreover, some subjects strictly favor these products to those of competitors. Question 6 asks whether subjects prefer the products to those of the competitors. There are 87 cases (34 percent), in which competitors receive less support from the investor (Table 7). However, in the majority of cases, investors had no strict preference for the own company's product. This is confirmed by answers to question 3, which asks whether subjects could imagine to buy a competing company's products. Only 50 Students (22 percent) exclude this possibility (Table 4).

Another test, that we performed, was to compare the mean portfolio shares of investments of agents who prefer products to those of the competitors (question 6) to those of agents who do not prefer the products. It turns out that the mean investment share of agents with a strict preference for the product is 26.37 percent, whereas agents with a weak preference invest 23.54 percent of their budget on average. This difference is significant at the 5.5 percent level. Accordingly, the preference with respect to competitors' goods plays a major role in determining the quantitative composition of the subjects' portfolios. We also performed the same type of analysis for the other questions. However, we found no significant differences in other cases.

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[5] Given the truncated payoff structure (31) another strategy might have been more reasonable: to pick the stock with the highest volatility.

Company	Region	Absolute Share [Euro]	Number of Investors
MAN AG St O.N.	GER	394	15
Deutsche Postbank AG Na	GER	375	15
Henkel KGaA VZO O.N.	GER	365	14
Deutsche Börse Na O.N.	GER	330	10
BASF AG O.N.	GER	295	11
E.ON AG O.N.	GER	235	9
SAP AG O.N.	GER	215	10
Nokia Corp.	EU	194	9
ThyssenKrupp AG O.N.	GER	190	7
Daimler AG Na O.N.	GER	185	9
Siemens AG NA	GER	170	7
Volkswagen AG ST O.N.	GER	149	7
Deutsche Post AG NA O.N.	GER	145	6
Münch. Rückvers. VNA O.N.	GER	145	6
Air Liquide S.A.	EU	140	4
Hypo Real Estate Hldg ST	GER	135	6
Commerzbank AG O.N.	GER	135	6
Allianz SE VNA O.N.	GER	135	6
Société Générale S.A.	EU	120	5
Total S.A.	EU	120	5
Deutsche Bank AG NA O.N.	GER	109	3
Bay. Motoren Werke AG ST	GER	105	5
Lufthansa AG VNA O.N.	GER	105	4
Eni S.p.A.	EU	100	3
RWE AG ST O.N.	GER	95	3
Metro AG ST O.N.	GER	95	6
Infinion Tech.AG NA O.N.	GER	90	3
Fresen.Med.Care KGaA ST	GER	85	4
Bayer AG O.N.	GER	84	4
Philips Electronics N.V.	EU	75	3
Linde AG O.N.	GER	74	3

Company	Region	Absolute Share [Euro]	Number of Investors
Suez S.A.	EU	70	2
TUI AG NA	GER	70	2
Merck KGaA O.N.	GER	65	3
Unilever N.V.	EU	63	3
Repsol YPF S.A.	EU	60	3
UniCredito Italiano S.p.A.	EU	55	2
telefonica S.A.	EU	55	3
Iberdrola S.A	EU	53	2
Arcelormittal S.A.	EU	50	1
Vinci S.A.	EU	50	2
Intesa Sanpaolo S.p.A.	EU	50	2
LVMH S.A.	EU	50	2
Adidas AG O.N.	GER	45	2
RWE AG St	EU	45	2
Telecom Italia S.p.A.	EU	40	1
Carrefour S.A.	EU	35	2
Renault S.A.	EU	30	2
Vivendi S.A.	EU	30	1
Fortis AG	EU	30	2
Sanofi-Aventis S.A.	EU	28	2
L'Oréal S.A.	EU	25	2
Alcatel S.A.	EU	20	1
Crédit Agricole S.A.	EU	20	1
Assicurazioni Generali S.p.A.	EU	20	1
ING Groep N.V.	EU	20	1
France Télécom	EU	20	1
Groupe Danone S.A.	EU	17	1
BNP Paribas S.A.	EU	15	1
Enel S.p.A.	EU	0	0
Saint-Gobain S.A.	EU	0	0
Banco Bilbao Vizcaya Argent	EU	0	0
Aegon N.V.	EU	0	0

Company	Region	Absolute Share [Euro]	Number of Investors
Schneider Electric S.A	EU	0	0
Continental AG O.N.	GER	0	0
Banco Santander Central Hispano S.A.	EU	0	0
AXA S.A.	EU	0	0
Deutsche Telekom AG NA	GER	0	0

Table 2

Question 1: Do you know the company's products?

Yes, many of them	some	a few	No	no answer
1	2	3	4	*na*
83	88	38	46	3

Table 3

Question 2: Could you imagine to buy the company's products?

Yes	perhaps	rather not	no	no answer
1	2	3	4	*na*
113	53	21	41	30

Table 4

Question 3: Could you imagine to buy a competing company's products?

Yes	perhaps	rather not	No	no answer
126	50	26	24	32

Table 5

Question 4: Do you like the company's products?

Yes, very much	They are OK	rather not	No	no answer
37	154	10	1	56

Table 6

Question 5: Have you ever bought a product from this company?

Yes, frequently	sometimes	rarely	No, never	no answer
30	52	30	124	22

Table 7

Question 6: Do you prefer the products to those of the competitors?

Yes	No	no answer
87	169	2

Table 8

Question 7: What do you think about the company's product prices?

Cheap	appropriate	high	too high	no answer
11	97	54	7	89

Table 9

Question 8: Would you consider the company to be an attractive employer?

Yes	perhaps	rather not	no	no answer
66	109	47	15	21

5.3 Comparison of answers

We also asked all 63 students the same eight questions about eight relatively popular stocks - independently of their previous portfolio choice. These stocks were Bayerische Motoren Werke, Daimler, Groupe Danone, L'Oréal, LVMH, Nokia, Renault, and Volkswagen. We had to restrict the number of companies in order avoid that students get tired over too many questions (note that they had to answer 8 x 8 questions in this last round). The results enable us to compare the statements of subjects who bought a stock with those of non-buyers. Tables 10-17 summarizes the answers for all subjects.

Accordingly, 95 percent of the students who bought shares of the 8 selected companies stated that they like the companies products more or less. In contrast more than 12 percent of the students who did not buy these companies' state that they do not like the corresponding products. Among the 8 students who did not like a product at all only one bought the stock of the corresponding company. Answers to question 3 reveal that 77% of shareholders could imagine to buy competitors' products. The corresponding Figure is larger for non-shareholders (93%). The Question on pricing policy (question 7) reveals that 64% of shareholders have a positive attitude and only 45% of non-shareholders. Finally 74% of shareholders consider their company as an attractive employer while only 56% of non-shareholders do.

Table 10

Question 1: Do you know the company's products?

Yes, many of them	some	a few	No	no answer
256	155	27	56	1

Table 11

Question 2: Could you imagine to buy the company's products?

Yes	perhaps	rather not	no	no answer
235	127	68	30	44

Table 12

Question 3: Could you imagine to buy a competing company's products?

Yes	perhaps	rather not	No	no answer
330	98	21	11	44

Table 13

Question 4: Do you like the company's products?

Yes, very much	They are OK	rather not	No	no answer
102	296	48	7	51

Table 14

Question 5: Have you ever bought a product from this company?

Yes, frequently	sometimes	rarely	No, never	no answer
47	103	63	263	28

Table 15

Question 6: Do you prefer the products to those of the competitors?

Yes	No	no answer
155	349	0

Table 16

Question 7: What do you think about the company's product prices?

Cheap	appropriate	high	too high	no answer
7	19	175	232	78

Table 17

Question 8: Would you consider the company to be an attractive employer?

Yes	perhaps	rather not	no	no answer
91	166	109	89	49

6 Discussion

The present paper has two main theoretical results. First, in a simple linear environment, a non-cooperative Bayesian investment game can efficiently replace a forward market. Second, efficiency only obtains, when all consumer-investors own enough initial wealth to

signal their consumption needs via the capital market. The reason is that agents with little wealth cannot transmit their private information about the desirability of innovations to companies through the capital market.

The first result relies on the linearity assumption of the production technology. In a symmetric equilibrium, investments are proportional to the share of agents who care about the good. With a strictly concave production technology, prices would be higher in the high state than in the low state - which is not compatible with efficiency. Nevertheless, an additional efficiency loss should arise in the case of an unequal society, where wealth constraints prevent that investments react monotonously to the number of consumers who care about a particular good.

Another key assumption of this paper is that rich investors cannot acquire any information about other consumers' consumption needs. There is indeed a good reason to assume that such information is not available for free. In the present setup, all consumers who care about the new good would have an incentive to overstate their preferences, because any additional investment reduces the future equilibrium prices and therefore increases individual wealth. This is why any costless mechanism of market research would fail to provide useful information. Likewise, a welfare maximizing government would not have free access to the relevant information.

The present paper does not investigate the case of costly market research. A market research mechanism could reward participants according to their stated preferences for consumer goods (e.g. with shares of the respective company). Costly market research may also be performed by financial intermediaries who, in many countries account for a large fraction of actual investments. As we have seen, individual investors tend to favor investments in companies that produce final products rather than inputs. It would be interesting to study the investment and market research decisions of intermediaries in such a setup. Another interesting topic for future theoretical research is the dynamics of investments and product prices when wealth is distributed unequally.

The experimental evidence in this paper is clearly in favor of the hypothesis of consumption driven investment. It would be worthwhile to use data on aggregate investments to study whether consumption driven investment directs resources into particular companies or sectors of the economy.

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