A Blessing in Disguise? Market Power and Growth with Financial Frictions

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Abstract

Firm market power raises growth in the presence of financial frictions. The reason is that self financing becomes more effective if firm earnings are higher. We test this mechanism using Korean manufacturing data 1963-2003. We find that more concentrated sectors grow faster. This positive empirical relationship between concentration and growth gets weaker as credit becomes more abundant. Using a simple growth model, we study counterfactuals. The observed rise of concentration in Korea until the mid-1970s has increased manufacturing value added 1963-2003 on average by at least 0.6% per year. The effect of firm market power on worker welfare is ambiguous.

Keywords: market power, financial frictions, growth.
JEL classifications: L13, O11, O16.

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1. Introduction

Low and middle income countries typically have underdeveloped financial markets.[1] This makes it difficult for firms to raise sufficient capital (e.g. Buera and Shin (2013)). Self financing through retained firm earnings becomes an important channel of capital accumulation (Midrigan and Xu (2014), Moll (2014)). Self financing is more effective if firms can use their market power to increase earnings. This simple observation motivates the main question of this paper: Can firm market power increase economic growth?

We study this question both theoretically and empirically. First, we develop a simple growth model of a small open economy with financial frictions and study the role of market power for growth. We proceed to test the model predictions using data from the Korean manufacturing sector 1963-2003. In the final part of the paper, we parametrize our model economy to match key statistics from the Korean manufacturing sector and study the effects of counterfactual competition policies.

In our model, a given number of identical firms produces output using capital and labor. Firms finance capital through equity and debt subject to a borrowing constraint. If the borrowing constraint is binding, output is inefficiently low.

In this environment, we find that firms with market power reduce hiring and production in order to lower wages and increase firm earnings. A temporary increase in market power therefore always lowers output today. But it also raises output tomorrow if borrowing constraints are binding. In this case, production is constrained by firms' net worth. Higher earnings today raise firms' net worth tomorrow which allows them to borrow more and increase capital and production. Because of the increase in capital, also wages are higher tomorrow.

Binding borrowing constraints are both sufficient and necessary for a positive effect of market power on growth. If firms are unconstrained, a temporary increase in market power still reduces wages and increases firm earnings today but does not affect output tomorrow.

In order to test these model predictions, high quality micro data from a developing economy is needed in order to construct an empirical measure of market power. We use information from the Korean manufacturing census 1963-2003. Since the data from the first census waves is not machine-readable, it rarely has been used in the literature before. South Korea is an attractive environment to test our model mechanism because the sample period covers its transition from a poor agricultural country to an industrialized high-income economy. This rapid growth occured in spite of underdeveloped financial markets. As the demand for credit exceeded supply, the government restricted credit access to a limited number of large firms (Kim and Leipziger (1993)). This policy contributed to high levels of firm concentration (Amsden (1992)).

The manufacturing census contains sector-level information about aggregates of establishments in different size groups. We use this information to estimate the underlying establishment size distribution and calculate concentration-based measures of market

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[1]Private Credit to GDP, Deposits to GDP, or Private Bond and Stock Market Capitalization to GDP all feature a strong positive correlation with GDP per capita. See Beck, Demirgüç-Kunt, and Levine (2010).

power. We find that concentration is hump-shaped over time. This is in line with previous findings which suggest that active industrial policies in Korea have encouraged the initial rise and subsequent fall in concentration.

We build a panel with sector-level information on concentration at different census dates. Controlling for sector- and year-fixed effects, we find that the labor share is lower in more concentrated sectors. This result is consistent with firms which use their market power to distort wages in order to increase firm earnings. We also find that more concentrated sectors grow faster. The positive empirical relationship between concentration and growth gets weaker over time as credit becomes more abundant. Again, this is in line with our model mechanism. Higher earnings in more concentrated sectors allow firms to grow faster. As firms' borrowing constraints become less tight, the positive effect of market power on growth weakens.

In the final part of the paper, we use our simple growth model to study counterfactuals. We parametrize our model economy to replicate the growth experience of the Korean manufacturing sector 1963-2003. In our model economy, growth is driven by three exogenous forces: (1.) TFP growth, (2.) financial development, and (3.) changes in market power. Using our parametrized model, we can study the effect of counterfactual competition policies on Korea's transition path.

In a first experiment, we compare Korea's actual time path of concentration to a counterfactual scenario of constant and low market power. We find that the initial rise in concentration until the mid-1970s and the subsequent fall have increased manufacturing value added 1963-2003 on average by at least 0.6% per year. This gain occurs because of accelerated capital accumulation. Wages are depressed initially and do not rise above their counterfactual level before 1991. The discounted flow of worker consumption 1963-2003 is lowered by 0.61 percent.

It need not always be the case that workers lose out after an increase in firm market power. Since the positive effect of market power on growth is strongest when firm net worth is scarce, we compare Korea's gradual rise in concentration to an instantaneous jump. In this counterfactual, the average growth rate of output during the 60s increases by at least 1 percentage point per year. Wages are lowered during the 60s, but they are persistently raised afterwards because of accelerated capital accumulation. The discounted flow of total worker consumption 1963-2003 increases by 0.12 percent. Worker welfare increases as well if the intertemporal elasticity of substitution is sufficiently high.[2]

In Section 2, we briefly survey some related literature. Section 3 describes the model environment. The equilibrium allocation is characterized in Section 4. We test the model predictions in the empirical part of Section 5. In Section 6, we parametrize our model economy and study counterfactuals. Concluding remarks follow. All proofs are deferred to the appendix.

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[2]The result that workers may be willing to accept lower wages today in exchange for accelerated capital accumulation which increases wages tomorrow is reminiscent of Judd (1985).

2. Related Literature

The paper which is most closely related is Galle (2016). Independently of us, he develops a model with financial frictions in which market power affects the allocation of capital within a stationary distribution of heterogeneous firms. In contrast, we study the transition path of an economy with identical firms. There is no problem of misallocation across firms, but the economy as a whole has too little capital. Faster accumulation of capital increases aggregate growth. Both in the data as well as in our parametrized model economy we find that a given increase in market power has stronger effects on growth at earlier stages of development. This time-varying role of market power is absent from a stationary environment as in Galle (2016). Using Indian establishment-level data, he also provides empirical evidence for the role of market power in improving self financing. His findings and our empirical results, using data from different countries and different time periods, complement one another.

Itskhoki and Moll (2014) study optimal tax policies in an economy with financial frictions similar to ours. Like us, they find that policies which increase profits of constrained firms can accelerate growth. In their framework, it is optimal to subsidize labor in order to increase output and profits when firms are severely borrowing-constrained. Workers are compensated for higher labor supply through higher wages in the future when firms have accumulated more capital. This policy is very different from the variations in firm market power studied by us. Market power increases profits through an initial *reduction* in labor and output. Note that in Itskhoki and Moll (2014) an increase in firm market power would correspond to a tax hike on labor which is rebated in lump sum to firms. The policy maker does not have this option in the setup of Itskhoki and Moll (2014). Besides studying an alternative 'policy' (i.e. marker power), our paper also differs because we do not solve an optimal policy problem. We rather study the actual historical behavior of concentration in Korea and use our model to compare the resulting allocation to counterfactual scenarios.

Motivated by policies observed in China, Song, Storesletten, and Zilibotti (2014) study the effect of several policy interventions in an economy with financial frictions. A reduction of the real exchange rate lowers the real wage which improves self financing by borrowing-constrained firms. An increase in the interest rate paid on government bonds lowers the capital-labor ratio of unconstrained firms which again lowers wages and improves self financing by constrained firms. Since these policies lower wages and increase labor, output, and profits of constrained firms, they work in a similar way as the labor subsidies considered by Itskhoki and Moll (2014). In contrast to our paper, Song et al. (2014) do not consider variations in firm market power.

Our paper builds on an extensive theoretical literature studying the effect of financial frictions on misallocation and growth.[3] The self financing channel in particular is described by Banerjee and Moll (2010), Midrigan and Xu (2014), and Moll (2014). We

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[3]A non-exhaustive list includes Marcet and Marimon (1992), Banerjee and Newman (1993), Galor and Zeira (1993), Aghion and Bolton (1997), Piketty (1997), Giné and Townsend (2004), Jeong and Townsend (2007), Erosa and Cabrillana (2008), Greenwood, Sanchez, and Wang (2010), Buera, Kaboski, and Shin (2011), Buera and Shin (2013), and Caselli and Gennaioli (2013).

contribute to this literature by studying the role of market power in improving self financing. In contrast to models of misallocation, we abstract from heterogeneity among firms in order to focus on aggregate growth.[4]

Endogenous growth models often feature a trade-off between incentives for innovation (e.g. through patents) on the one hand and competition on the other hand (e.g. Romer (1990), or Aghion and Howitt (1992)). The trade literature entertains the notion that 'infant industries' should be shielded from international competition because of 'Learning-by-Doing' spillovers to productivity growth as in Clemhout and Wan (1970), Krugman (1987), or Lucas (1988). In contrast, in our model technology is exogenous and the effect of market power on growth operates exclusively through the accumulation of capital.

In the empirical part of the paper, we use data from South Korea to test our model predictions. Several of our empirical results complement findings by Jeong and Masson (1990) on the role of concentration in Korea's manufacturing sector 1976-81.

The empirical relevance of market concentration is not limited to transition economies. Grullon, Larkin, and Michaely (2016) show that more than 75% of US industries have experienced an increase in concentration levels over the last two decades. Also Barkai (2016) and Autor, Dorn, Katz, Patterson, and Reenen (2017) document that sales concentration has been rising in the US and that increased concentration is associated with falling labor shares. This finding echoes our empirical result on the negative relationship between firm concentration and the labor share in Korea. Given the high level of financial development in the US, we do not expect a positive effect of concentration on growth. As a matter of fact, Gutiérrez and Philippon (2017) find a negative relationship between market power and capital growth in the US. This finding underlines our result that the role of market power for growth depends on a country's stage of development.

3. Model Setup

Our model is designed to highlight the effect of market power on growth through capital accumulation in the presence of financial frictions. It deliberately abstracts from other effects market power might have on growth (e.g. in endogenous growth models) in order to illustrate the capital accumulation channel as clearly as possible.

We study a deterministic growth model of a small open economy populated by two groups of agents: workers and capitalists. Workers are hand-to-mouth. They supply labor to domestic firms which are owned by capitalists. There is an exogenous number Z_t of domestic firms. Since we choose consumption as the numéraire, all distortions from market power will affect the labor market and the wage rate w_t.

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[4]The analytical tractability of heterogeneous agent economies like in Moll (2014) relies on firm policies that are linear in net worth. Without perfect competition, firm policies are concave in net worth. Our assumption of homogeneous firms preserves tractability even in the absence of perfect competition.

3.1. Workers

There is a representative worker. Workers are hand-to-mouth and do not take any intertemporal decisions.[5] Their intratemporal valuation of consumption and labor is described by:

$$c_t^w - \frac{\gamma}{2} l_t^2 \,, \tag{1}$$

where c_t^w is worker consumption at date t, and l_t is labor supplied. We choose consumption as the numéraire and denote the wage rate by w_t. It follows for workers' budget constraint in period t:

$$c_t^w \leq w_t l_t \,. \tag{2}$$

3.2. Firms

There is an exogenous number Z_t of domestic firms.[6] All firms are identical. Each firm employs k_t units of capital and n_t units of labor to produce:

$$y_t = A_t k_t^\alpha n_t^{1-\alpha} \,. \tag{3}$$

Firms' capital stock is financed through equity and debt: $k_t = e_t + d_t$, where e_t is an individual firm's stock of equity invested by domestic capitalists, and d_t is the amount borrowed at time t on the international bond market. Firms are subject to the following borrowing constraint:

$$d_t \leq \lambda_t e_t \,. \tag{4}$$

Because of the borrowing constraint, a firm's total stock of capital cannot exceed $(1+\lambda)e_t$. The parameter λ_t measures the severeness of financial frictions. If λ_t is low, the maximum amount of firm leverage is low as well.[7]

Firm earnings are:

$$\pi_t = A_t k_t^\alpha n_t^{1-\alpha} - w_t n_t - \delta k_t - r d_t \,, \tag{5}$$

where δ is the rate of depreciation, and r is the interest rate on the international bond market.

If the number of firms Z_t is smaller than infinity, a firm is not a price taker. In this case, the wage rate depends on the individual firm's labor demand n_t as well as the labor

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[5]We could allow workers to save and borrow. For our purposes, a sufficient assumption is that workers do not invest as much of their savings in firm equity as firm owners do. This assumption seems to be a reasonable approximation for many economies given that stock markets are often underdeveloped (e.g. Beck et al. (2010)) and stock market participation is limited (e.g. Campbell (2006)).

[6]Alternatively, we could endogenize the number of firms by assuming an exogenous non-pecuniary entry cost. Firms would enter as long as equilibrium earnings are higher than the entry cost. This alternative modelling choice would not affect any of our results.

[7]This borrowing constraint can be motivated by firms' inability to commit to full repayment of their debt. Similar constraints are motivated and studied by Banerjee and Newman (1993), Buera and Shin (2013), or Moll (2014).

demand $\tilde{N}_t$ by the $Z_t - 1$ remaining firms:

$$w_t = F(n_t, \tilde{N}_t) \,. \tag{6}$$

3.3. Capitalists

There is a representative capitalist. Capitalists value consumption and do not work:

$$\sum_{i=0}^{\infty} \beta^i \log \left(c_{t+i}^k \right) \,. \tag{7}$$

Capitalists own domestic firms and receive dividends. They do not have access to the international bond market but they can accumulate equity of domestic firms. Their period t budget constraint is:

$$c_t^k + a_{t+1} \leq a_t R_t \,, \tag{8}$$

where a_t is beginning-of-period t aggregate firm equity, and R_t is the gross return on equity. Since all Z_t firms are identical, each of them collects an equal amount of equity at the beginning of period t: $a_t = Z_t e_t$. At the end of period t, capitalists' have earned: $a_t R_t = Z_t(e_t + \pi_t)$. A standard No-Ponzi-scheme condition rules out that capitalists are short in equity indefinitely:

$$\lim_{T \to \infty} \frac{a_{t+T+1}}{\Pi_{j=1}^{T} R_{t+j}} \geq 0 \,. \tag{9}$$

4. Equilibrium

An equilibrium is characterized by:

1. Individual optimization:

   a) Workers choose c_t^w and l_t to maximize (1) subject to their budget constraint (2),

   b) Firms choose n_t and k_t to maximize (5) subject to the borrowing constraint (4) and the equilibrium wage (6),

   c) Capitalists choose c_t^k and a_{t+1} to maximize (7) subject to their budget constraint (8) and the No-Ponzi condition (9);

2. Market clearing: The labor market clears: $l_t^* = Z_t n_t^*$. The market for domestic equity clears: $a_t = Z_t e_t$. The goods market clears: $Z_t y_t^* = c_t^{w*} + c_t^{k*} + I_t^* + NX_t^*$, where: $I_t^* \equiv Z_{t+1} k_{t+1}^* - Z_t k_t^*(1 - \delta)$, and $NX_t^* \equiv Z_t d_t^*(1 + r) - Z_{t+1} d_{t+1}^*$.

4.1. Capitalists' Problem

At the end of period t, capitalists divide their wealth $a_t R_t$ between consumption c_t^k and savings a_{t+1}. Since utility is logarithmic, the model is deterministic, and atomistic

capitalists take the rate of return R_t as given, this savings problem has a simple solution in closed form.

Lemma 4.1. *Capitalists consume a fixed fraction of their wealth:*

$$c_t^{k*} = (1 - \beta)a_t R_t \,.$$

Proofs can be found in the appendix. Lemma 4.1 implies a simple law of motion for aggregate firm equity:

$$a_{t+1}^* = \beta a_t R_t = \beta Z_t(e_t + \pi_t) \,. \tag{10}$$

4.2. Workers' Problem

Workers are hand-to-mouth. Their only decision is intratemporal. Using (2), their maximization problem at time t becomes:

$$\max_{l_t} \quad w_t l_t - \frac{\gamma}{2} l_t^2 \,. \tag{11}$$

From the first order condition we derive the optimal labor supply:

$$l_t^* = \frac{w_t}{\gamma} \,. \tag{12}$$

4.3. Firm Problem

A firm solves:

$$\max_{d_t, k_t, n_t, w_t} \quad A_t k_t^\alpha n_t^{1-\alpha} - w_t n_t - \delta k_t - r d_t \,, \tag{13}$$

$$\text{subject to:} \quad k_t = e_t + d_t \,, \tag{14}$$

$$d_t \leq \lambda_t e_t \,, \tag{15}$$

$$w_t = F(n_t, \tilde{N}_t) \,. \tag{16}$$

Using optimal labor supply ($w_t = \gamma l_t^*$) together with market clearing ($l_t^* = n_t + \tilde{N}_t$), we can re-write the last constraint as: $w_t = F(n_t, \tilde{N}_t) = \gamma(n_t + \tilde{N}_t)$. This problem can be reduced to the choice of two variables: capital and labor. An interior solution to the optimal choice of k_t satisfies:

$$\alpha A_t \left(\frac{n_t}{k_t^*}\right)^{1-\alpha} - \delta = r \,. \tag{17}$$

The marginal product of capital equals the marginal cost r. Note that k_t^* may be larger than $(1 + \lambda_t)e_t$. This happens if financial development (measured by λ_t) is low and equity e_t is scarce. In this case, the firm is borrowing-constrained and optimally sets

$k_t = (1 + \lambda_t)e_t$. The first order condition for n_t is:

$$(1 - \alpha)A_t \left(\frac{k_t}{n_t^*}\right)^\alpha = \gamma(n_t^* + \tilde{N}_t) + \gamma n_t^* . \tag{18}$$

The marginal product of labor equals its marginal cost. One part of the marginal cost of labor is the wage rate $w_t = \gamma(n_t^* + \tilde{N}_t)$. A second part is the effect of the non-atomistic firm's labor demand on the equilibrium wage. By demanding an additional unit of labor, the firm increases the equilibrium wage by γn_t^*.

4.4. Results

The exogenous number of firms Z_t is an indicator of market power in this economy. If Z_t is low, each firm has a big impact on equilibrium prices. Since consumption is the numéraire good, the only price which can be distorted is the wage rate w_t. There is a limited number Z_t of firms which buy labor services, and there is an infinite number of workers who supply labor. Lemma 4.2 gives a standard oligopsony result.

Lemma 4.2. *A reduction in the number of firms Z_t lowers the equilibrium wage w_t^*. A reduction in Z_t increases aggregate firm earnings $Z_t \pi_t^*$.*

Since the labor supply curve is upward-sloping, a non-atomistic firm can reduce the wage by demanding less labor. This incentive for an individual firm to reduce labor demand becomes stronger as Z_t is reduced. As firms gain market power, wages fall and aggregate firm earnings increase.[8] In the presence of binding borrowing constraints, this has important implications for growth.

Proposition 4.3. *A reduction in Z_t lowers aggregate output $Z_t y_t^*$, employment l_t^*, and worker consumption c_t^{w*} today, but it increases aggregate output $Z_{t+j} y_{t+j}^*$, employment l_{t+j}^*, and worker consumption c_{t+j}^{w*} in all future periods $t + j$ in which firms' borrowing constraint is binding.*

A reduction in the number of firms Z_t has the standard effect of increased market power on the equilibrium outcome today. Firms strategically reduce hiring to lower the equilibrium wage. This implies lower output, employment, and worker consumption. The effect on the equilibrium outcome tomorrow is more interesting. An increase in market power today results in higher aggregate firm earnings $Z_t \pi_t^*$ which translates into higher aggregate firm equity a_{t+1} tomorrow:

$$a_{t+1}^* = \beta a_t R_t^* = \beta Z_t(e_t + \pi_t^*) = \beta(a_t + Z_t \pi_t^*). \tag{19}$$

If borrowing constraints are binding in $t+1$, aggregate output, labor demand, and wages are all increasing functions of aggregate firm equity a_{t+1}. More equity allows firms to

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[8]Our choice of consumption as the numéraire does not affect any of the results. If we had chosen leisure as the numéraire good, market power would distort the price of the consumption good. Obviously, only relative prices matter. Output, labor, and the real wage would be distorted in exactly the same way as described above.

borrow more and increase their stock of capital. Complementarity in production between capital and labor raises the equilibrium wage w_{t+1}^* and worker consumption c_{t+1}^{w*}.

Proposition 4.4 underlines the crucial role of binding borrowing constraints for the mechanism described above. If borrowing constraints are slack, market power has no positive effect on growth.

Proposition 4.4. *If borrowing constraints in period $t + j$ are slack, a reduction in Z_t leaves aggregate output $Z_{t+j} y_{t+j}^*$, employment l_{t+j}^*, and worker consumption c_{t+j}^{w*} unaffected.*

A necessary condition for the positive effect of market power on growth from Proposition 4.3 is that aggregate output, labor demand, and wages are increasing functions of aggregate firm equity a_{t+j}. If borrowing constraints are slack, firms operate at the efficient scale of production k_{t+j}^*. An increase in a_{t+j} affects how much firms borrow (or lend) on the international bond market but it leaves the scale of production k_{t+j}^* unchanged.

Comparative Statics. Market power raises growth if and only if borrowing constraints are binding. The co-movement between the elasticity of growth with respect to changes in market power on the one hand, and the abundance of credit on the other hand is an empirically testable property of the model. Proposition 4.5 summarizes how this elasticity and the credit-to-output ratio evolve along a country's transition path.

Proposition 4.5. *Assume that borrowing constraints are binding today and tomorrow. The credit-to-output ratio d_t^*/y_t^* increases in aggregate firm equity a_t and the borrowing limit λ_t, and falls in technology A_t.*
The elasticity of aggregate output tomorrow $Z_{t+1} y_{t+1}^*$ with respect to changes in Z_t ...

... decreases in aggregate firm equity a_t,

... increases in the borrowing limit λ_t,

... increases in technology A_t,

if and only if:

$$1 \geq \delta(1 + \lambda_t) + \lambda_t r. \tag{20}$$

Condition (20) is always satisfied for empirically plausible values for λ_t, δ and r.[9] In a growing economy, aggregate firm equity a_t, the borrowing limit λ_t, and technology A_t all tend to increase over time. This means that Proposition 4.5 does not predict a unique co-movement between the abundance of credit and the elasticity of growth with respect to market power. In Section 6.2, we will derive a quantitative prediction for a parametrized economy.

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[9]If firms are constrained, λ_t is the aggregate debt-to-equity ratio of non-financial firms. Empirical evidence suggests a value below one (e.g. Rajan and Zingales (1995)).

5. South Korea 1963 - 2003

We have studied a model economy with financial frictions in which growth may depend positively on firms' market power. The described mechanism is relevant whenever capital is scarce and financial frictions are severe. It is generally difficult to empirically test the role of market power for growth because little high-quality micro data is available for low-income countries.

South Korea's growth experience is an exception in this respect. We use Korean census data on manufacturing establishments 1963 - 2003. The data from the first census waves is not machine-readable and rarely has been used before. The time span 1963 - 2003 covers South Korea's transition from an underdeveloped agricultural country to an industrialized high-income economy. In 1963, South Korea had only recently emerged from the division of the country after the Korean War 1950-1953. GDP per capita was lower than in Niger, the Philippines, or Bolivia. While in 1963, Portugal was three times as rich as South Korea, in 2003 GDP per capita in South Korea and Portugal were roughly equal.[10]

5.1. Data and Descriptive Statistics

The manufacturing census in South Korea covers all manufacturing establishments with five or more employees. It was first carried out in 1963. The next wave followed in 1966. Since 1968, the census is published in five-year intervals. This allows us to use ten census waves between 1963 and 2003.

The basic unit is always a manufacturing establishment (i.e. a factory, workshop, or office). Depending on the census year, data is available for eight to twenty-three manufacturing sectors and for seven to twelve different establishment size categories. In order to make our empirical measures comparable across time, we always use the same eight sector categories and the same four size categories.[11]

Korea's rapid economic growth is especially pronounced in manufacturing. According to the census, manufacturing real value added 1963-2003 grows at a yearly rate of 12.9%. The annual growth rate of real capital is even higher: 14.3%. The total number of manufacturing workers increases by 4.9% per year.

As shown in the left panel of Figure 1, this rapid growth occured in spite of underdeveloped credit markets. It is not before 2000 that the ratio of credit to GDP in Korea reaches the level of Japan in the 1960s. This suggests that financial frictions are important during a large part of the sample period.

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[10]This information is from the National Accounts Main Aggregates Database by the United Nations Statistics Division: http://unstats.un.org/unsd/snaama/dnllist.asp

[11]The eight manufacturing sectors are Food, Beverage and Tobacco; Textiles, Wearing Apparel and Leather; Wood and Furniture; Paper and Publishing; Rubber, Chemicals and Petroleum; Non-metallic Mineral products (Clay, Glass, Stone); Basic Metal; and Fabricated Metal, Machinery and Equipment. The four size categories are 50-99 workers; 100-199; 200-499; and 500 and more. Focusing on establishments above 50 workers avoids potential problems which might arise from time-varying data quality for smaller establishments.
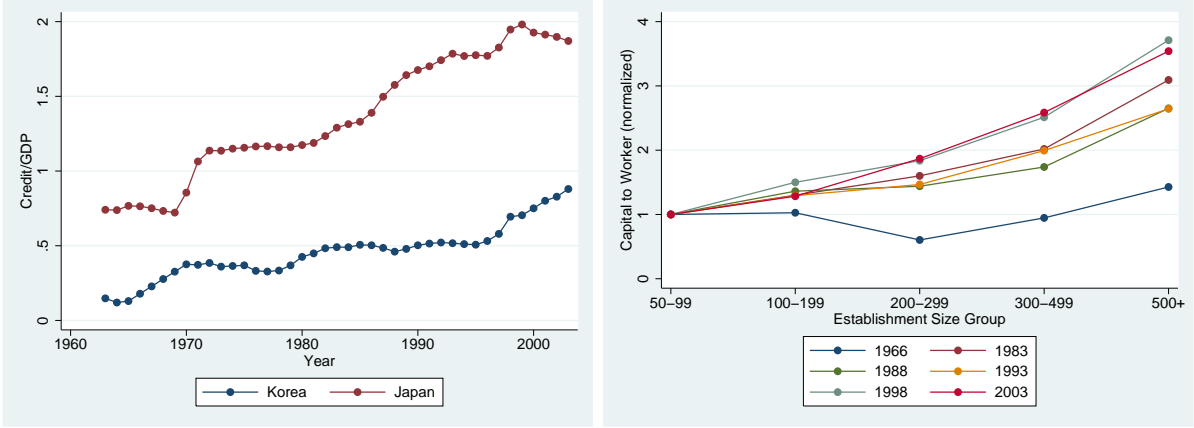
Figure 1: Financial Development.

Note: Credit / GDP is private credit by deposit money banks and other financial institutions relative to GDP. The data is from the current edition of Beck et al. (2010). The right panel displays the ratio of capital (tangible fixed assets) to workers. Values of a given year are normalized by dividing by the ratio in size category 50-99.

Our model predicts that an increase in market power accelerates growth if and only if firms with market power are borrowing-constrained. In practice, we expect market power to increase with size. It is therefore important to verify that financial frictions not only affect small establishments but also large ones. To do this, we take a look at the capital-labor ratio. In our model, the capital-labor ratio is increasing in the borrowing limit λ_t.[12] The right panel of Figure 1 shows how the capital-worker ratio varies across establishment size groups (whenever this information is available). In 1966, the capital-labor ratio is essentially flat across size. This is different for later years. We conclude that during the early part of the sample period the borrowing limit λ_t seems to be similar for large establishments and for small ones. This suggests that initially even large establishments with market power are subject to financial frictions.

5.2. Market Power

We use the Korean manufacturing census to answer the following questions: (1.) How has firms' market power changed over time? (2.) How have changes in market power affected firm earnings and worker compensation? (3.) How have changes in market power affected firm growth?

Given the data limitations we face, we proxy market power by concentration. Lacking market-level data, we measure concentration at the sectoral level assuming that individual markets within a given sector are similar. Ideally, we would proxy market power through firm concentration instead of establishment concentration. Notwithstanding

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[12]If the borrowing constraint is binding, an individual firm's capital-labor ratio is:

$$\frac{k_t}{n_t} = \left(\frac{\gamma(Z_t + 1)(1 + \lambda_t)e_t}{(1 - \alpha)A_t} \right)^{\frac{1}{1+\alpha}} . \tag{21}$$

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these limitations, the empirical results reported below suggest that our empirical proxies indeed capture information on firm market power.

In order to measure sector concentration, we need information about the entire establishment size distribution. The manufacturing census does not contain data for individual establishments. The finest disaggregation available is information on the aggregate of all establishments within a given size category. We use this information to estimate the underlying establishment size distribution. We exploit the fact that establishment size in our sample is well approximated by a Pareto distribution. Based on the estimated size distributions, we calculate sector-specific and time-varying measures of concentration.

5.2.1. Estimation of Establishment Size Distributions

The empirical literature finds that firm size is well approximated by a Pareto distribution (e.g. Axtell (2001)). We test this hypothesis for establishment size in our sample. We measure establishment size by the number of workers x. If establishment size is Pareto, the share of total employment in establishments above size x and below x_u is:

$$W(x) = \frac{x_u^{1-\sigma} - x^{1-\sigma}}{x_u^{1-\sigma} - x_m^{1-\sigma}}, \tag{22}$$

where x_m is the minimum establishment size x_m. A derivation can be found in the appendix. We use the method of moments to estimate the only parameter σ. As moment condition, we assume that equation (22) holds in our data on average. At each of the ten census dates and in each of the eight manufacturing sectors, as well as *Total Manufacturing*, we can use census data to calculate the empirical realization of $W(x)$ for $x = \{100, 200, 500\}$. For our purposes, it is safe to assume that there are no establishments with more than $x_u = 10,000$ workers.[13] As a lower bound, we set $x_m = 50$.[14] If establishment size in our data is generated by a Pareto distribution, our estimation should yield a good fit.

As shown in Table 1, this is very much the case. The goodness of fit is higher in sectors with a higher total number of establishments. Figure 2 shows the census data for *Total Manufacturing* at two points in time. 1978 is the date when the fit of the Pareto distribution is worst (as measured by R^2); 1993 is the date with the best fit. Even in 1978, the Pareto distribution captures the non-linear shape of the empirical employment shares very well. In 1993, the empirical employment shares and the fitted values are barely distinguishable. We conclude from the goodness of fit measures reported in Table 1 that establishment size in our sample is well approximated by a Pareto distribution.[15]

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[13]For $x_u = \infty$ and $\sigma \leq 1$, both the numerator and the denominator in (22) equal infinity. This undesirable property is of no concern once we fix an upper bound $x_u < \infty$.

[14]Focusing on the upper tail of establishments avoids potential problems which might arise from time-varying data quality for smaller establishments.

[15]The goodness of fit is highly similar if we repeat this exercise with more data points using $x_m = 5$ and $W(x)$ for $x = \{10, 20, 50, 100, 200, 500\}$.

Table 1: Goodness of fit

Sector	Obs	R^2: Min	Max	Mean
Total Manufacturing	10	0.991	0.999	0.997
Food Beverage Tobacco	10	0.972	0.999	0.988
Textiles Apparel Leather	10	0.976	0.999	0.993
Wood Furniture	10	0.836	0.999	0.969
Paper Publishing	10	0.923	0.989	0.964
Chemicals Petroleum	10	0.988	0.999	0.998
Mineral	10	0.918	0.999	0.973
Basic Metal	10	0.948	0.999	0.989
Fabricated Metal Machinery	10	0.992	0.999	0.997

Note: For each sector, as well as for total manufacturing, and for each census date, we use the method of moments to estimate σ. This is a total of 90 regressions.
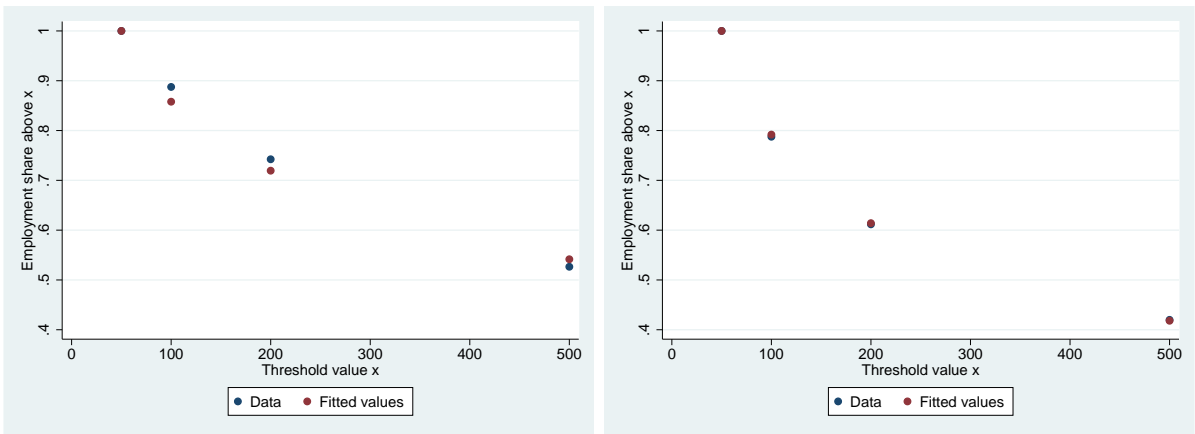

Figure 2: Employment shares 1978 (left panel) and 1993 (right panel).
Note: The panels display the share of workers in establishments of size x or higher in 1978 and in 1993. The estimate $\hat{\sigma}$ of the power law exponent is 1.04 (in 1978) and 1.23 (in 1993). Adjusted R^2: 0.991 (in 1978) and 0.999 (in 1993).

5.2.2. Concentration

Our preferred proxy for market power is the employment share of the largest 5% of establishments in sector s and date t. We calculate this concentration ratio using our estimates $\hat{\sigma}$:

$$C_t^s(\hat{\sigma}) \equiv W(x_{5\%}) = \frac{x_u^{1-\hat{\sigma}} - x_{5\%}^{1-\hat{\sigma}}}{x_u^{1-\hat{\sigma}} - x_m^{1-\hat{\sigma}}}, \tag{23}$$

where $x_{5\%}$ is given by the estimated Pareto distribution:

$$x_{5\%}: \quad \Pr[X \geq x_{5\%}] = 0.05 \quad \Leftrightarrow \quad x_{5\%} = \frac{x_m}{0.05^{\frac{1}{\hat{\sigma}}}}. \tag{24}$$

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A high value of the concentration ratio $C_t^s(\hat{\sigma})$ indicates that a small fraction of establishments employs a large share of total employment in sector s at time t. It is therefore an indication of high market power.

The upper left panel of Figure 3 shows how our measure of market power has evolved in the different sectors 1963-2003. In most sectors, concentration displays a hump-shaped pattern with a peak in the 1970s. The same hump-shaped pattern also emerges for the weighted average across sectors shown in the upper right panel of Figure 3. This hump-shaped pattern of concentration is in line with existing firm-level evidence.[16] Establishment- or firm-level data is not available before 1970.[17] Our measure adds to the existing evidence in that it dates back until 1963 and that it is constructed at the sectoral level.

The concentration ratio $C_t^s(\hat{\sigma})$ is our preferred measure of market power. In our empirical analysis below we will also report results using the Herfindahl-Hirschman Index. Details on its construction can be found in the appendix.

Industrial and Competition Policies in Korea

The steep initial rise in concentration from the early 1960s until the mid-1970s displayed in the upper right panel of Figure 3 falls into a time period of aggressive industrial policies. After the 1961 military coup led by Park Chung-hee, Korea pursued export-oriented industrialization policies which involved active promotion of industrial conglomerates, the *chaebols*. Kim and Leipziger (1993), p. 35.:

> "Since Korea began its industrialization with a highly underdeveloped equity market, industrialists had to rely heavily on bank loans - and most banks were owned by the government. When interest rates on bank loans were set below market clearing levels, demand for loans exceeded supply. It was therefore necessary for the government to ration loans by non-price mechanisms, which led to a concentration of economic power in a limited number of firms."

Exit of failing businesses was prevented "either by an outright bail-out or by asking another group with a sound financial base to take over the unsuccessful venture" (KL, p. 35.). A third factor which contributed to firm concentration were import restrictions and a protectionist trade regime during the 1960-70s (KL, p. 17.). During the same period, worker unions were supressed (Galenson (1992)). Jeong and Masson (1990):

> "Given imperfections in capital markets, one goal was to create domestic profits to fund investments and export expansion. Profits could better be attained by large firms in concentrated domestic markets (p. 455).

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[16]According to Harvie and Lee (2002), p.29, the share of the largest 100 manufacturing firms in total sales increased from 40.6 per cent in 1970 to 46.8 per cent in 1980. Lee (1986), p. 239, reports that the employment share of the largest business groups in manufacturing peaks in 1980. Kim (2016) documents that concentration in manufacturing is falling since the early 1980s. The peak of concentration in Figure 3 appears to occur somewhat earlier than 1980.

[17]For instance, Midrigan and Xu (2014) use establishment-level data from Korean manufacturing for the years 1991-1999.
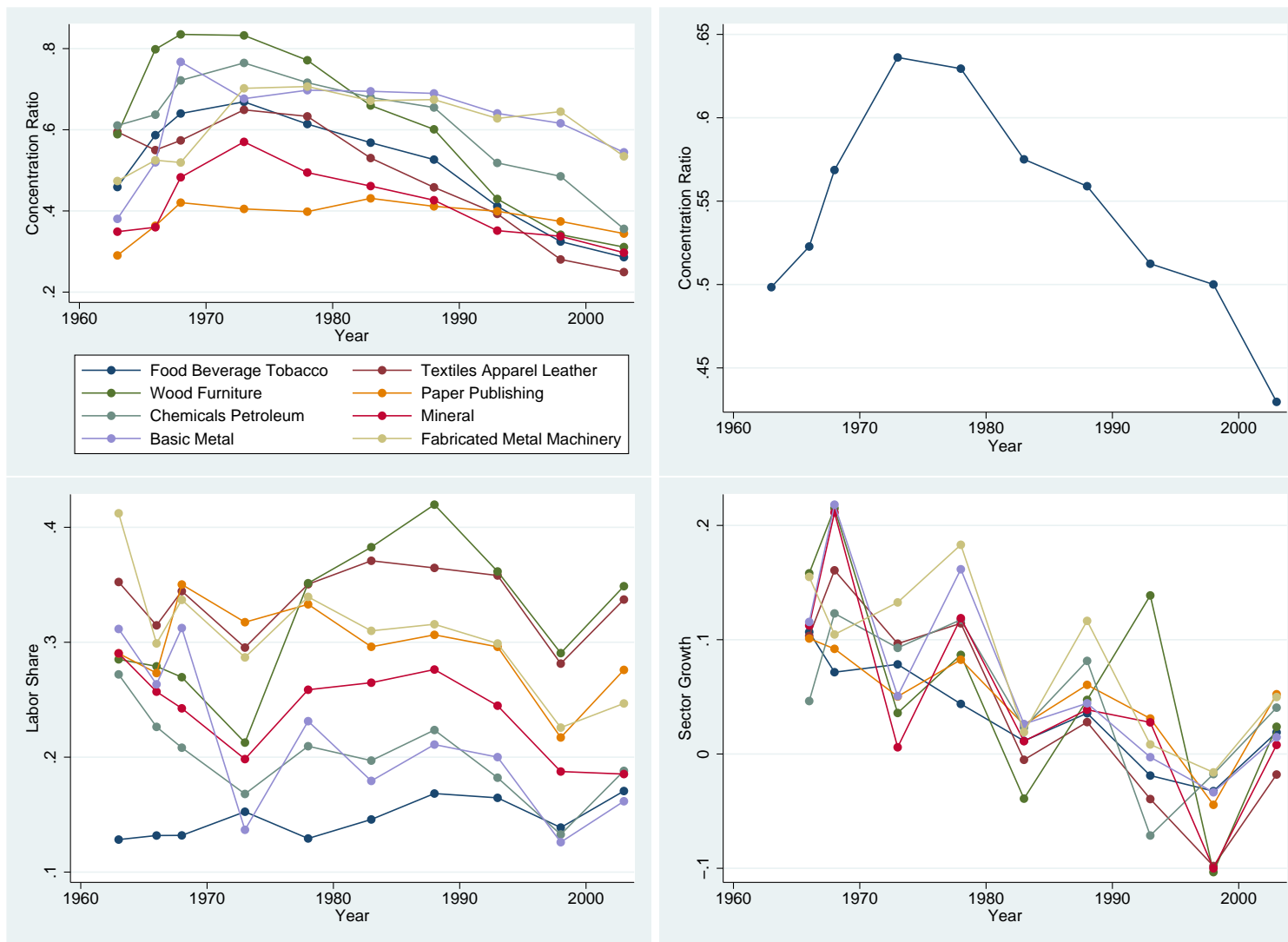
Figure 3: Concentration ratio $C_t^s(\hat{\sigma})$ across sectors (upper left) and weighted average (upper right); Labor Share LS_t^s (lower left); Sector Growth G_t^s (lower right).

The fall in concentration since the late 1970s displayed in the upper right panel of Figure 3 is consistent with profound political changes in Korea. At the end of the 1970s, Korea experienced a period of political unrest involving large scale student and worker demonstrations. After the assassination of Park Chung-hee in 1979, the government abandoned its active industrial policies (Stern, Kim, Perkins, and Yoo (1995), p. 35). In 1980, the Monopoly Regulation and Fair Trade Act was passed establishing for the first time an antitrust authority. Trade liberalization began in 1981 (KL, p. 17).

We conclude that active industrial and competition policies may have played an important role in generating the initial rise and subsequent fall in concentration.

5.3. Market Power and the Labor Share

How have changes in firms' market power affected firm earnings? Since direct information about firm earnings is not available, we use the labor share. Ceteris paribus, an increase in firm earnings implies a fall in the labor share. Our model predicts that the labor share is falling in concentration.

The lower left panel of Figure 3 shows the labor share in the eight manufacturing sectors 1963-2003.[18] We regress the labor share LS_t^s in a given sector at a given census date on the concentration ratio $C_t^s(\hat{\sigma})$. We always include time and sector-specific fixed effects and we cluster standard errors by sectors. The first column of Table 2 shows the regression coefficient for the concentration ratio $C_t^s(\hat{\sigma})$. At any point in time, sectors which display a particularly high level of concentration have a particularly low labor share. This result is consistent with firms which use their market power on the labor market to reduce wages and increase firm earnings.

Changes in the production technology may affect relative factor usage and therefore also the labor share. If these changes in technology are correlated with $C_t^s(\hat{\sigma})$, this might bias the results. In column (2), we include the natural logarithm of the real capital-worker ratio as control variable. Since we have no data on capital for the first census date 1963, the number of observations drops to 72. The capital-worker ratio enters the regression with the expected negative sign. We notice that the negative relationship between $C_t^s(\hat{\sigma})$ and LS_t^s is weaker now, but still statistically significant.

In our model, the capital-labor ratio is increasing in market power.[19] We should therefore expect some amount of collinearity between $C_t^s(\hat{\sigma})$ and the capital-labor ratio.

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[18]The labor share from the census is low compared to other data sources. For aggregate manufacturing, it fluctuates around a mean of about 25%. The OECD calculates for 1973-2003 a labor share in manufacturing between 50% and 65%. In contrast to the census, the OECD calculates value added as the value of output net of taxation. This reduces the denominator of the labor share. In addition, the OECD includes part of the income from self-employment in total labor compensation. This increases the numerator of the labor share. While the labor shares from census and OECD data differ in levels, their first differences have a correlation of 91 percent.

[19]Let K_t denote aggregate capital. In equilibrium, the aggregate capital-labor ratio is:

$$\frac{K_t}{l_t} = \left(\frac{Z_t + 1}{Z_t} \frac{\gamma K_t}{(1-\alpha)A_t} \right)^{\frac{1}{1+\alpha}} . \tag{25}$$

It is not obivous whether to prefer the estimate from column (1) or from column (2) where collinearity is a concern. We interpret the two estimates as upper and lower bounds for the coefficient of $C_t^s(\hat{\sigma})$.

The strength of the relationship between $C_t^s(\hat{\sigma})$ and the labor share is economically significant. Consider the rise by 27.6% (or 13.77 percentage points) in the weighted-average of concentration between 1963 and 1973 displayed in the upper right panel of Figure 3. According to our estimate from column (1), this increase in market power predicts a drop in the census labor share of 12.5% (or 3.28 percentage points) during the same time period. Using the lower bound estimate from column (2), the predicted fall in the census labor share still is 7.77% (or 2 percentage points). Accordingly, 1%-increase in $C_t^s(\hat{\sigma})$ is associated to a 0.28% decrease in the census labor share.

Columns (3) and (4) report results for an alternative statistic of market power. Instead of $C_t^s(\hat{\sigma})$, here we use the Herfindahl-Hirschman Index $HHI_t^s(\hat{\sigma})$ as a proxy for market power. Again we find a significant negative relationship between concentration and the labor share.[20]

5.4. Market Power and Growth

In this subsection, we study the relationship between concentration and growth. We measure sector growth by total sector employment. We prefer this real measure to nominal statistics like value added or capital. Our concern with nominal statistics is that Korea had high inflation rates above 10% until the mid-1980s. In the absence of sector-specific price indexes for the entire sample period, it is impossible to separate nominal from real sector growth.

Accordingly, sector growth G_t^s is the average yearly growth rate of employment e_t^s in sector s between census date t and $t+1$:

$$G_t^s = \frac{\log(e_t^s) - \log(e_{t-1}^s)}{\Delta year} \, , \tag{26}$$

where $\Delta year$ indicates the number of years between the two census dates t and $t+1$. The lower right panel of Figure 3 shows how sector growth differs across sectors and over time.

Our model predicts that an increase in market power in year t raises the average growth rate between year $t-1$ and $t+1$ if financial constraints are binding.[21] Since G_t^s measures the average yearly growth rate in the time span between two census dates (in most cases, this time span is five years), we expect a positive contemporaneous relationship between G_t^s and concentration if financial frictions are binding.

In our model, the relationship between concentration and growth depends on financial development. We proxy this variable by the ratio of *Credit / GDP*. In column (1) of Table

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[20]Our empirical results are consistent with Jeong and Masson (1990) who use firm-level data from Korean manufacturing sectors 1976-81 and estimate a positive relationship between concentration and profitability.

[21]An increase in market power in year t lowers y_t but increases y_{t+1} if financial constraints are binding. Growth between year $t-1$ and $t+1$ increases.

Table 2: Concentration and the Labor Share.

	(1) LS_t^s	(2) LS_t^s	(3) LS_t^s	(4) LS_t^s
$C_t^s(\hat{\sigma})$	-0.238**	-0.148*		
	(-5.17)	(-2.54)		
$\frac{\text{Capital}}{\text{Worker}}$		-0.0486		-0.0490
		(-2.19)		(-2.23)
$HHI_t^s(\hat{\sigma})$			-0.742***	-0.617***
			(-11.02)	(-6.03)
R^2	0.87	0.92	0.86	0.93
R^2 (FE only)	0.82	0.85	0.82	0.85
N	80	72	80	72

R^2 (FE only) is the R^2 of a fixed-effects regression without control variables.

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: Concentration and Sector Growth.

	(1) G_t^s	(2) G_t^s	(3) G_t^s	(4) G_t^s
$C_t^s(\hat{\sigma})$	0.384**	0.393**		
	(3.67)	(5.28)		
Credit/GDP	0.311*	0.414**	0.109	0.199**
	(3.03)	(5.05)	(1.47)	(4.34)
$C_t^s(\hat{\sigma})$*Credit/GDP	-0.670*	-0.686***		
	(-3.45)	(-5.59)		
Year	-0.0163*	-0.0238***	-0.0258**	-0.0331***
	(-2.43)	(-5.88)	(-4.59)	(-7.94)
E_t^s		0.584**		0.561**
		(4.65)		(4.68)
$HHI_t^s(\hat{\sigma})$			1.625***	0.920**
			(10.24)	(3.92)
$HHI_t^s(\hat{\sigma})$*Credit/GDP			-4.90***	-2.58**
			(-14.57)	(-3.77)
R^2	0.56	0.72	0.54	0.68
R^2 (FE only)	0.51	0.51	0.51	0.51
N	72	72	72	72

R^2 (FE only) is the R^2 of a sector-fixed-effects regression with a time trend and without control variables. t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

3, we regress sector growth on concentration and financial development. Importantly, we include an interaction term between $C_t^s(\hat{\sigma})$ and *Credit / GDP*. This specification allows us to estimate how the relationship between concentration and growth is affected by financial development. Since *Credit / GDP* only varies over time and not across sectors, we do not include year-fixed effects as before. Instead, we include a linear time trend. As before, we include sector-fixed effects and we cluster standard errors by sectors.

The regression coefficients of concentration reported in column (1) is positive and significant. The coefficient of the interaction with financial development is negative and significant. All results are robust to including a quadratic time trend and/or an interaction term between concentration and time. This implies that the positive effect of concentration on growth is not simply getting weaker over time. It is declining as credit becomes more abundant.

In the data, average *Credit / GDP* rises from 0.32 in the first half of the sample 1963-1982 to 0.58 in 1983-2003. This implies that the estimated positive relationship between concentration and growth gets weaker over time as credit becomes more abundant. In the first half of the sample period, a ten-percentage-point rise in $C_t^s(\hat{\sigma})$ is associated to an increase in G_t^s of 1.7 percentage points. The same rise in $C_t^s(\hat{\sigma})$ during the second half of the sample period implies almost no movement in G_t^s (a decrease of 0.07 percentage points).[22]

These results are very much in line with our model predictions. As credit grows over time, at some point firms may become unconstrained. We do not expect a positive effect of market power on growth in this case. But even while borrowing constraints are still binding, Proposition 4.5 predicts that the elasticity of growth with respect to market power co-moves with the credit-to-output ratio along a country's transition path. In Section 6.2, we show that our parametrized model generates a simultaneous rise in the credit-to-output ratio together with a decline in the elasticity of growth with respect to market power. This prediction is in line with the empirical results from column (1) of Table 3.

Since our model mechanism relies on growth through capital accumulation, we control for entry in column (2) of Table 3.[23] Indeed, entry is positively correlated with sector growth. However, other coefficients are barely affected. In column (3) and (4), we report results from the corresponding regressions substituting the Herfindahl-Hirschman Index $HHI_t^s(\hat{\sigma})$ for the concentration ratio $C_t^s(\hat{\sigma})$. Again, we find a positive and significant relationship between concentration and sector growth. This relationship gets weaker as credit becomes more abundant.

In the appendix, we report results from additional regressions using first differences. First differences have the advantage that there is no obvious time trend in *changes* to sector growth. The results confirm our findings from Table 3.[24]

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[22]The respective calculations are: $10 \times (0.384 - 0.32 \times 0.67) = 1.7$, and: $10 \times (0.384 - 0.58 \times 0.67) = -0.07$.

[23]Let z_t^s denote the total number of establishments in sector s at census date t. We measure entry as the growth rate of establishments: $E_t^s = [\log(z_t^s) - \log(z_{t-1}^s)]/\Delta year$.

[24]Our empirical results are consistent with Jeong and Masson (1990) who use firm-level data from Korean manufacturing sectors 1976-81 and estimate a positive relationship between concentration and

5.5. Discussion of Empirical Results

These empirical results are in line with our model predictions from Section 4. At the same time, they are not readily explained by alternative mechanisms. For instance, Buera and Shin (2013) present a model of perfectly competitive markets with financial frictions. They simulate transition paths which feature both endogenous changes in the firm distribution as well as fluctuations in growth over time. While such a model mechanism might potentially rationalize a positive correlation between concentration and growth, it is inconsistent with the negative relationship between concentration and the labor share. In the perfectly competitive model of Buera and Shin (2013), the labor share is constant.

Some part of the positive relationship between concentration and growth might be driven by incentives for innovation (in the spirit of Romer (1990) or Aghion and Howitt (1992)) or 'Learning-by-Doing' effects in protected industries (as in Clemhout and Wan (1970), Krugman (1987), or Lucas (1988)). Furthermore, Korea's industrial policies described above not only promoted firm concentration but often also subsidized selected firms or sectors. While our model and these alternative mechanisms are not mutually exclusive, these alternatives cannot explain why the positive relationship between concentration and growth gets weaker over time as credit becomes more abundant.

6. Model-based Counterfactuals

The empirical results point towards a positive relationship between market power and growth, in particular during the earlier part of Korea's high-growth period 1963-2003 when credit is tight. We can use our simple growth model to study counterfactuals. What would have happened if firm concentration had developed in a different way? To this end, we parametrize our model such that it replicates a number of empirical moments of the Korean growth experience.

6.1. Parametrization

The model period is one year. Growth is driven by three exogenous forces: (1.) TFP growth (A_t), (2.) financial development (λ_t), and (3.) changes in market power (Z_t). There is a group of parameter values which we choose independently of the moments generated from our model. We set agents' discount factor to $\beta = 0.97$. The interest rate on the international bond market is $r = 1/\beta - 1$. Initial output is normalized to $y_{1963} = 1$. The value of the preference parameter γ does not influence any variables of interest and is normalized to 1.[25]

Since our measure of concentration is calculated for the Korean manufacturing sector 1963-2003, we mainly use statistical moments from this sector. The parameter choice for

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industry growth. They remark that in developed countries concentration usually is negatively associated with industry growth.

[25]The preference parameter γ merely pins down the ratio of labor time to consumption (or other units measured by the numéraire).

Table 4: Parametrization

Variable	Description	Value	Target/Source
α	technology	0.288	av. manufacturing labor share G7 71.2%
β	discount factor	0.97	
γ	preferences	1	normalization
δ	depreciation	0.06	Nadiri and Prucha (1996)
r	riskless rate	$1/\beta - 1$	
y_{1963}	initial output	1	normalization
a_{1963}	initial wealth	0.87	annual growth real capital to workers 9.37%
LS_{1963}	initial labor share	0.6046	av. manufacturing labor share Korea 58.8%
A_t	TFP	Fig. 5	manufacturing real value added 1963-2003
λ_t	borrowing limit	Fig. 6	private credit to GDP 1963-2003
Z_t	number of firms	Fig. 4	predicted labor share 1963-2003

the technology parameter α pins down the labor share of a perfectly competitive economy with $Z_t = \infty$. We set α to match the average labor share in manufacturing of the G7 economies 1970-2003: 71.2%.[26] We therefore implicitly assume that the manufacturing sector of the G7 economies is perfectly competitive. The initial value of aggregate equity wealth a_{1963} is chosen to match the average yearly growth rate of the real capital-worker ratio. Table 4 reports our choice for the full set of parameter values.

Time-varying Exogenous Variables. The time path of Z_t is chosen in the following way. We use the (interpolated) time series for concentration in Korean manufacturing displayed in the upper right panel of Figure 3. Furthermore, we have an empirical estimate of the quantitative relationship between concentration and the labor share. The regression from column (2) in Table 2 implies that a 1%-increase in $C_t^s(\hat{\sigma})$ is associated to a 0.28% decrease in the census labor share. The regression from column (1) suggests an even stronger co-movement. For our standard parametrization, we choose the lower value in order to be conservative.[27]

We combine the time series for concentration in manufacturing from Figure 3 with this estimate and obtain a time series of predicted percent *changes* in the aggregate labor share. It remains to pin down the average *level* of the labor share. We target the average OECD labor share for manufacturing in Korea 1970-2003: 58.8%. We prefer the OECD labor share to the census labor share because we use OECD data to parametrize α. The left panel of Figure 4 shows the predicted time path for the labor share which would have arisen, if the only variation over time had been due to the fluctuations in concentration from Figure 3. Because concentration peaks in the mid-1970s, the predicted labor share falls until this point and rises afterwards. The unique time path for Z_t which matches

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[26]This data is from the OECD. The manufacturing labor share for the U.S. 1970-2003 is almost identical to the G7-average: 71.6%.

[27]In the counterfactual exercises, we also report results for an alternative parametrization which uses the higher estimate from column (1) of Table 2.
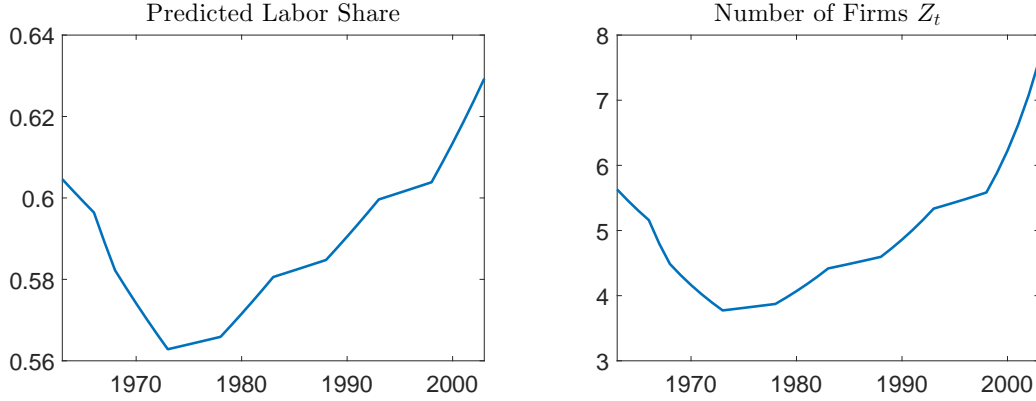
Figure 4: Predicted Labor Share and Z_t.

this predicted labor share is shown in the right panel of Figure 4.[28]

Two remarks about the labor share are in order. (1.) The average manufacturing labor share in Korea (58.8%) is very different from the U.S. (71.6%) or the average G7 country (71.2%). In our parametrization, we attribute this difference entirely to differences in market power. This procedure may overstate the difference in market power between Korea and the average G7 country. It is therefore important to note that the results of our counterfactuals primarily depend on *changes* in market power relative to a given level, and not so much on the exact *level* of market power in Korea. (2.) Besides changes in market power, there are many additional factors which induce fluctuations in the actual labor share. In our model, we abstract from all of these additional factors. We are merely interested in labor share fluctuations which are caused by changes in market power. These are the fluctuations in the labor share which are affected by counterfactual time paths of market power.

Total factor productivity A_t is chosen to perfectly match the growth rate of (interpolated) real value added in manufacturing year-by-year. In the left panel of Figure 5, we observe that real value added initially grows at high annual rates above 20 percent. This boom period comes to an abrupt end with the oil crisis in the late 1970s. Afterwards, manufacturing value added continues to grow at lower rates. The right panel of Figure 5 displays the implied behavior of A_t in our model.[29]

The borrowing constraint λ_t is chosen to exactly replicate the time series of *Credit /GDP* in Korea. The left panel of Figure 6 shows *Credit /GDP*. A clear upward trend in financial deepening is detectable with an acceleration since the mid-1990s. In the right panel of Figure 6, we observe that our model matches the steady increase in *Credit /GDP* through two periods of intense growth in λ_t. According to our model, financial

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[28]In this simple model, the variable Z_t should not be interpreted as the actual total number of firms in Korean manufacturing. One may think of Z_t as the average total number of firms in a given location- and skill-specific labor market.

[29]Buera and Shin (2013) show how to generate endogenous TFP growth in transition economies through a reduction in misallocation across heterogeneous firms. This channel is absent from our model.
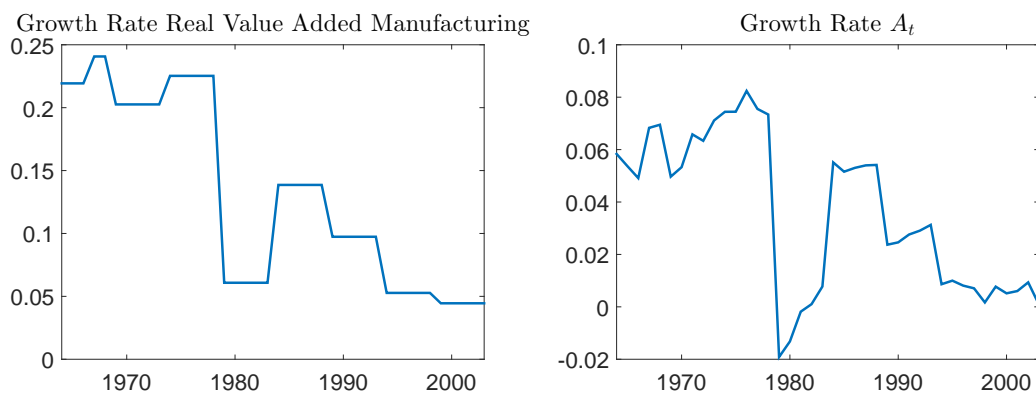
23

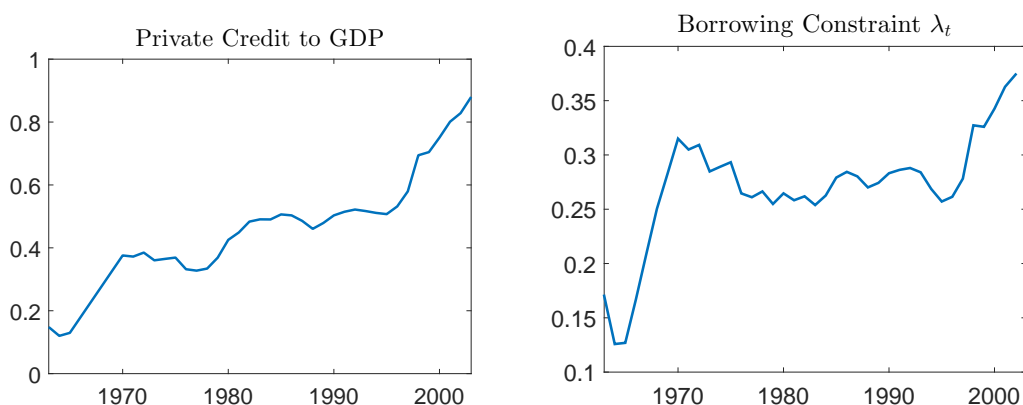Figure 5: Yearly growth in manufacturing real value added and growth in A_t.

Figure 6: Private credit to GDP and λ_t.

development improved rapidly in the 1960s, stagnated afterwards, and took off again in the mid-1990s.[30]

Untargeted Moments. To assess if our parametrization is reasonable, we can use untargeted moments. The left panel of Figure 7 shows the annual growth rate of real capital in manufacturing. Initially, capital grows at an astonishing speed of around 30% per year. This growth rate falls over time reaching a value close to zero at the end of the sample. The reason that our model can replicate this decreasing pattern is that the return to capital R_t is falling as firms accumulate net worth. At the aggregate level, there are decreasing returns because of convex disutility of labor.

In the right panel of Figure 7, we see annual growth in the total number of manufacturing workers. Initial growth rates above 10% per year reflect structural change as workers migrate from Korea's rural agricultural sector to manufacturing. The model counterpart of the number of manufacturing workers is labor supply l_t. As labor demand increases over time, the representative worker increases labor supply to the manufacturing sector.

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[30]Given our parametrization, firms become unconstrained in the year 2003. Small changes in λ_t have no effect on the equilibrium allocation if the borrowing constraint is slack. This is why our model cannot match private credit to GDP in 2003.
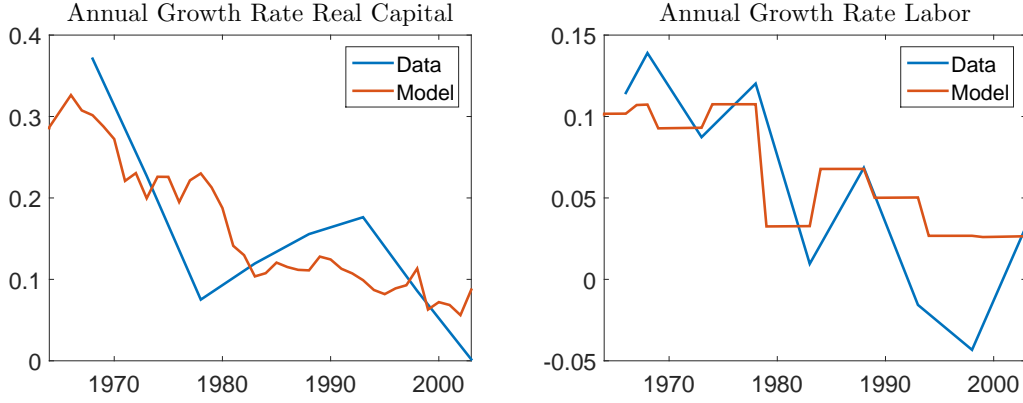
Figure 7: Untargeted moments - Growth rates of capital and labor.

The disutility of work in our model can be interpreted as migration costs from rural to urban areas. Evidently, our model misses the strong negative impact of the Asian crisis on manufacturing employment.

6.2. One-time Increase in Market Power

In the empirical analysis, we find that the positive relationship between concentration and growth gets weaker as credit becomes more abundant. In our parametrized model, the borrowing limit λ_t is chosen to match the observed rise in the credit-to-output ratio. Since a_t, λ_t, and A_t all grow simultaneously, Proposition 4.5 does not predict a unique co-movement between the credit-to-output ratio and the elasticity of growth with respect to changes in market power.

In this subsection, we derive a quantitative prediction. We study the effect of an increase in market power at two different points in time: in 1964 and in 1996. At both dates, Z_t drops by an identical amount which lowers the labor share by 11.5% (or 6.9 percentage points). Z_{t+1} is kept constant. As shown in Figure 6, *Credit/GDP* is 12% in 1964. By 1996, it has increased to 53%. Also aggregate firm equity is rising between 1964 and 1996. Our model generates an endogenous average yearly growth in a_t of 16%.

In Figure 8, we notice that the strong rise in aggregate firm equity a_t dominates the simultaneous increase in λ_t and A_t. The elasticities of aggregate firm equity a_{t+1} and aggregate value added $Z_{t+1}\pi_{t+1}^*$ fall over time. Aggregate firm equity a_{t+1} increases on impact by 3% in 1965, but only by 1.7% in 1997. The one-time increase in market power raises the average growth rate of value added 1964-65 by 1.2 percentage points. In 1996-97, it increases only by 0.7 percentage points. Accordingly, our parametrized model generates a simultaneous rise in the credit-to-output ratio together with a decline in the elasticity of growth with respect to changes in concentration. This prediction is in line with the empirical results from Table 3.
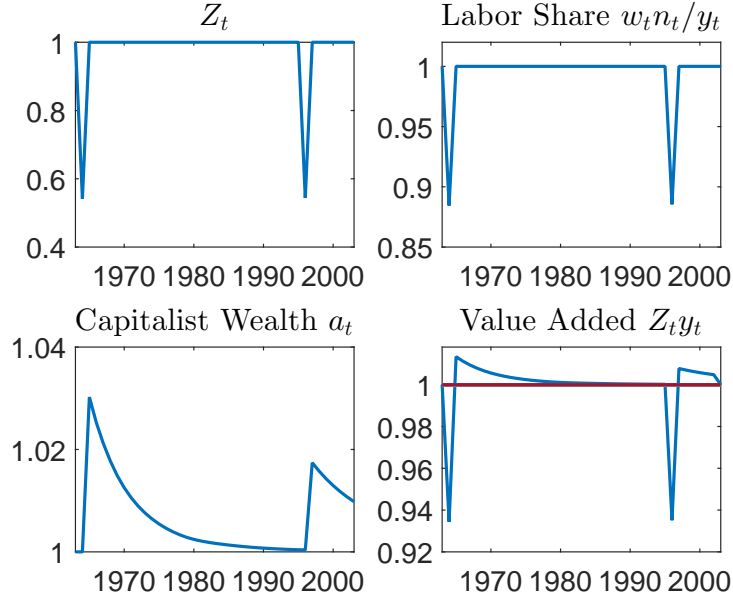
25

Figure 8: Effect of drop in Z_t at different points in time.

6.3. Counterfactual 1 - Korea's Industrial Policies

Until now, we have treated the level of market power as an exogenous variable. The evidence cited in Section 5.2.2 suggests that Korea's industrial policies have actively contributed to the initial rise and subsequent fall in concentration. Our first counterfactual experiment studies the effects of these changes in firm concentration.

To this end, we simulate a counterfactual economy in which concentration does not follow a hump-shaped pattern over time but remains constant at its initial 1963 level until the year 1997 (when concentration falls below its initial level). After this date, it follows the actual time path of concentration from the benchmark economy. Figure 9 compares the counterfactual with the benchmark economy which is parametrized to match the actual pattern of concentration over time. Since the counterfactual economy avoids the initial rise and subsequent fall in market power, the benchmark economy has a lower labor share and a lower number of firms in each year 1964-97.

Figure 10 compares the equilibrium outcome of the two economies. For the moment, we focus on the solid blue lines. The upper left panel shows the difference between the labor share in the benchmark economy and in the counterfactual. A lower labor share implies higher firm earnings and accelerated growth in capitalists' wealth a_t. As a result of Korea's industrial policies, a_t is about 9% higher in 1981 than in the counterfactual with constant and low market power.

The steep increase of market power in the benchmark economy relative to the counterfactual implies that the initial impact on output is negative. Firms achieve higher
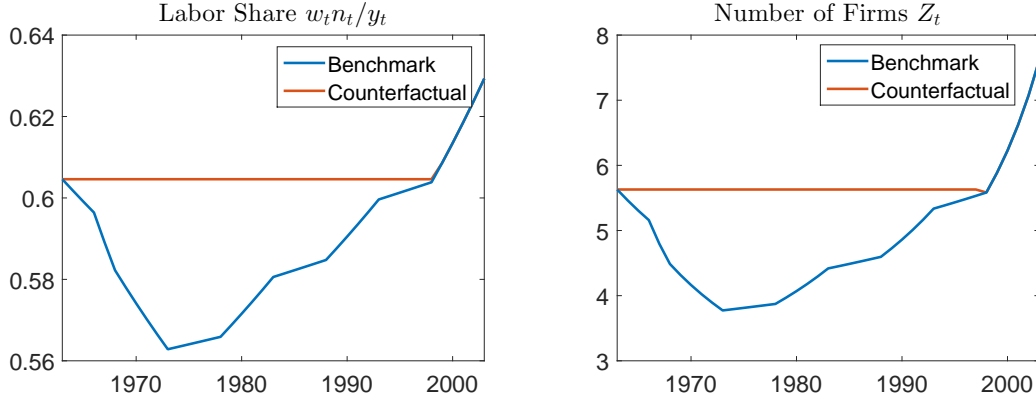
Figure 9: Counterfactual 1 - Benchmark vs. Constant Market Power.

earnings through strategic reductions in hiring and output. Eventually, the accelerated accumulation of capitalists' wealth a_t allows them to borrow more and scale up production. After 1978, output is persistently higher in the benchmark economy (until firms' borrowing constraint becomes slack). On average, value added 1963-2003 increases by 0.6 percentage points per year.

The lower left panel of Figure 10 displays the difference between growth rates in the two economies. Repeated increases of market power in the benchmark economy initially lower the average annual growth rate 1964-68 by 0.37 percentage point. Eventually, the accelerated accumulation of capital raises growth. During 1974-83, the annual growth rate is on average 0.36 percentage points higher in the benchmark economy than in the counterfactual with constant market power.

The increase in firm earnings is achieved through reduced hiring and depressed wages. The lower row of Figure 10 compares worker consumption c_t^w and labor supply l_t in the two economies. As a result of Korea's competition policy, in 1973 worker consumption falls to 92% relative to the counterfactual with constant market power. It is not before 1991 that the accelerated accumulation of capital results in higher consumption and labor supply in the benchmark economy relative to the counterfactual. Over the entire sample period 1963-2003, the discounted flow of worker consumption in the benchmark economy is 0.61% lower than in the counterfactual.

In our standard parametrization described above, we use the estimate from column (2) in Table 2 to pin down the movements in the labor share which are induced by the hump-shaped pattern of concentration displayed in the upper right panel of Figure 3. The regression from column (1) in Table 2 suggests an even stronger co-movement between concentration and the labor share. According to the estimate from column (1), a 1%-increase in $C_t^s(\hat{\sigma})$ is associated to a 0.45% decrease in the labor share. The dashed green lines in Figure 10 are based on a new parametrization using this higher estimate.[31] Assuming a stronger comovement between concentration and the labor share

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[31]With respect to the standard parametrization described above, the only changes are: $a_{1963} = 0.82$, $LS_{1963} = 0.6148$, and in the time series of Z_t. The predicted changes in the labor share are higher now which implies more movement in Z_t compared to the standard parametrization.
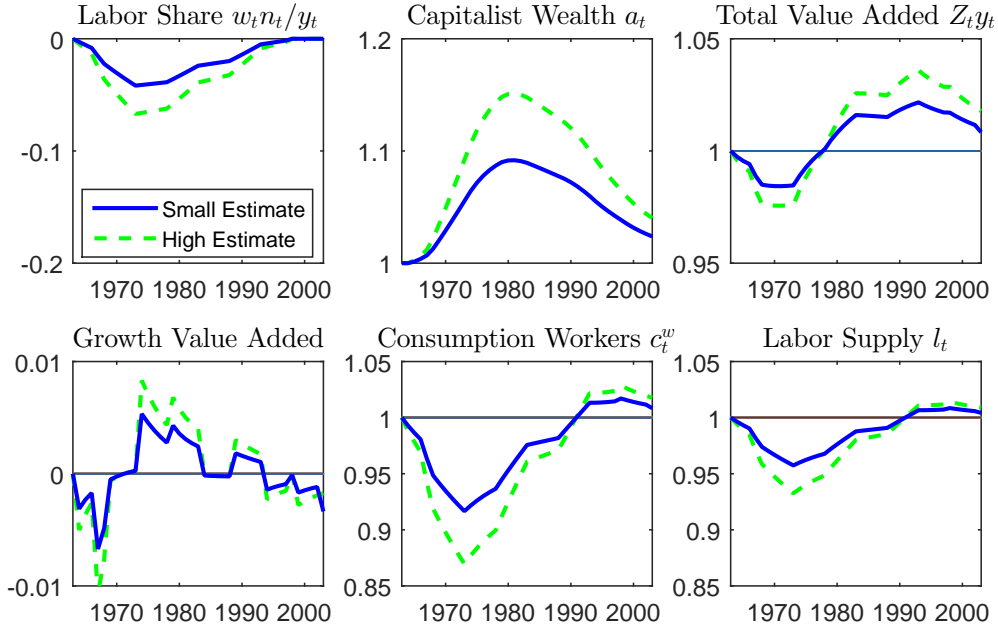
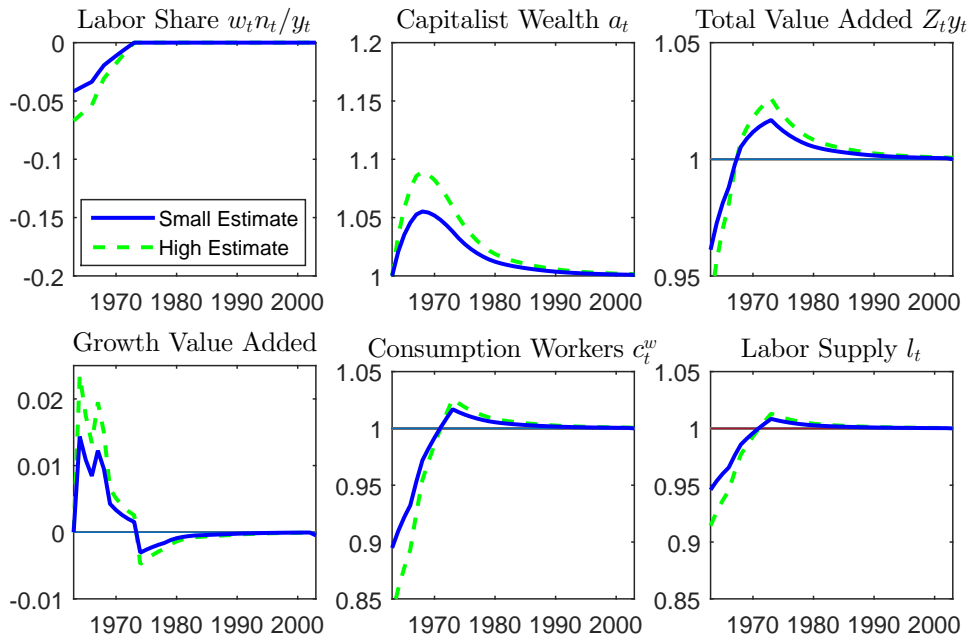Figure 10: Counterfactual 1 - Benchmark vs. Constant Market Power.

Figure 11: Counterfactual 2 - Initially High Market Power vs. Benchmark.

Note: In both figures, the upper left panel shows the difference between the labor share in the benchmark economy and in the counterfactual. The lower left panel shows the difference between annual growth of value added in the benchmark economy and in the counterfactual. All other panels show ratios of the respective variable in the benchmark economy relative to the counterfactual. The solid blue line shows results using the 'small estimate', that is, the coefficient for $C_t^s(\hat{\sigma})$ from column (2) in Table 2. The dashed green line shows results using the 'high estimate', that is, the coefficient from column (1) in Table 2.
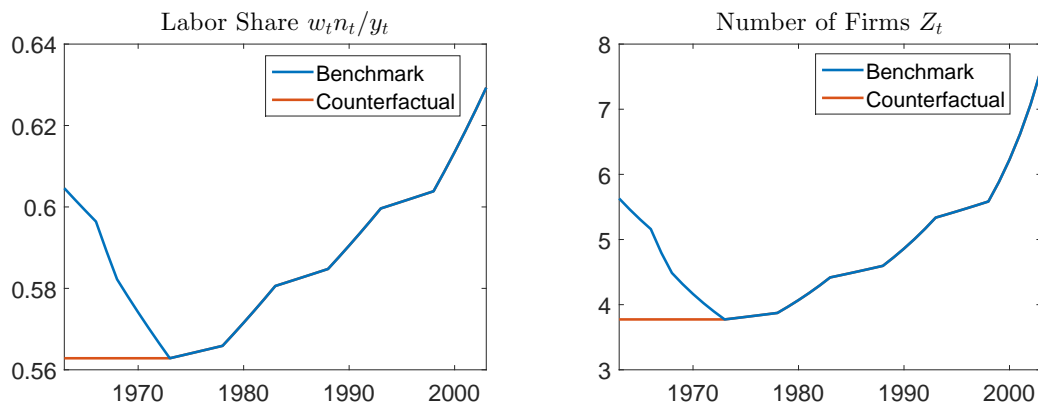
28

Figure 12: Counterfactual 2 - Initially High Market Power vs. Benchmark.

implies larger movements in all variables.

We conclude that the initial rise and subsequent fall in concentration induced by Korea's industrial policies has increased output since 1978 and worker consumption since 1991. Value added increases on average but the discounted flow of worker consumption falls. The post-1991 gains are not nearly enough to compensate workers for their initial losses 1963-1991. Since worker consumption and period utility are also less stable over time, it is clear that workers in 1963 do not prefer the hump-shaped pattern of concentration induced by Korea's industrial policy. In the following counterfactual, we show that in general the effect of an increase in market power on worker welfare is ambiguous.

6.4. Counterfactual 2 - Initially High Market Power

We know from Section 6.2 that the effect of an increase in market power on growth is getting weaker over time. This motivates our second counterfactual. We compare the gradual rise in concentration induced by Korea's actual competition policy to an instantaneous jump to its peak level. Figure 12 compares this counterfactual to the benchmark economy. In each year 1963-73, the counterfactual has a lower labor share and a lower number of firms Z_t.

The effects of the initially higher levels of market power in the counterfactual are displayed in Figure 11. Again, we first focus on the solid blue lines from the standard parametrization. The difference between the labor share in the benchmark and the counterfactual is largest in the beginning of the sample period. This is different with respect to Section 6.3 where the largest difference occured in the mid-1970s. This explains why the effect on capitalists' wealth a_t peaks much earlier.

The initial drop in output is deeper, but it is shorter lived. The subsequent rise is of similar magnitude as in Section 6.3 but it lasts much longer. After 1968, output is persistently higher in the counterfactual. The lower left panel of Figure 11 shows that the faster accumulation of capital in the counterfactual raises the average annual growth rate 1964-69 by 1 percentage point. Just as output, worker consumption and labor supply initially fall more strongly than in Section 6.3. On the upside, the initial losses

for workers do not last as long. Worker consumption is higher in each period between 1971 and 2003. Over the entire sample period 1963-2003, the discounted flow of worker consumption in the counterfactual is 0.12% higher than in the benchmark economy.

The dashed green line shows the effects of the counterfactual using the alternative parametrization with a higher estimate for the comovement between concentration and the labor share. As in Section 6.3, using the higher estimate results in stronger effects.

Worker Welfare. The counterfactual increase in market power raises the discounted flow of worker consumption 1963-2003 by 0.12% relative to the benchmark economy. But since worker consumption (and period utility) is also less stable over time, it is not obvious if workers in 1963 prefer the counterfactual to the benchmark economy. This depends on workers' intertemporal elasticity of substitution.

Since workers are hand-to-mouth and do not take any intertemporal decision, we did not need to specify workers' intertemporal preferences. Now we assume that workers rank different time paths of consumption c_t^w and labor l_t according to:

$$\sum_{i=0}^{\infty} \beta^i \frac{\left(c_{t+i}^w - \frac{\gamma}{2} l_{t+i}^2 \right)^{1-\rho} - 1}{1 - \rho}, \quad \rho \geq 0. \tag{27}$$

Their intratemporal valuation of consumption c_t^w versus labor l_t is the same as specified above in Section 3. The parameter ρ controls workers' aversion against fluctuations in period utility over time. A high value of ρ implies a low intertemporal elasticity of substitution. Higher future gains are needed to compensate for a given loss today.

Figure 13 shows the welfare gain for workers in 1963 from introducing the counter-factual time path of initially higher levels of market power.[32] We notice that workers' relative valuation of the counterfactual time path of market power is higher if ρ is smaller. As ρ approaches 0 (and the intertemporal elasticity of substitution approaches ∞), workers clearly prefer the counterfactual. But as ρ rises towards higher values, workers soon begin to prefer the benchmark economy.

There are two reasons why higher values of ρ reduce workers' relative valuation of the counterfactual scenario. First of all, an increase in market power always introduces additional fluctuation to workers' time path of consumption. It lowers wages today and raises them tomorrow. These fluctuations are more costly to workers if the intertemporal elasticity of substitution is low. The second reason is that wages and worker consumption are growing during the sample period. An increase in market power implies losses for the relatively poor workers of today and gains for the relatively rich workers of the future. The higher is ρ, the more costly is this redistribution from the poor workers of today to the rich workers of tomorrow.[33]

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[32]Since in the benchmark economy and in the counterfactual firms are unconstrained in 2003 and since Z_t is identical after the year 1973, it suffices to compare the equilibrium outcomes 1963-2003. Worker consumption and labor supply are identical afterwards.

[33]Van Binsbergen, Fernández-Villaverde, Koijen, and Rubio-Ramírez (2012) estimate an intertemporal elasticity of substitution of 1.73. This implies a value for ρ of $1/1.73 = 0.58$.
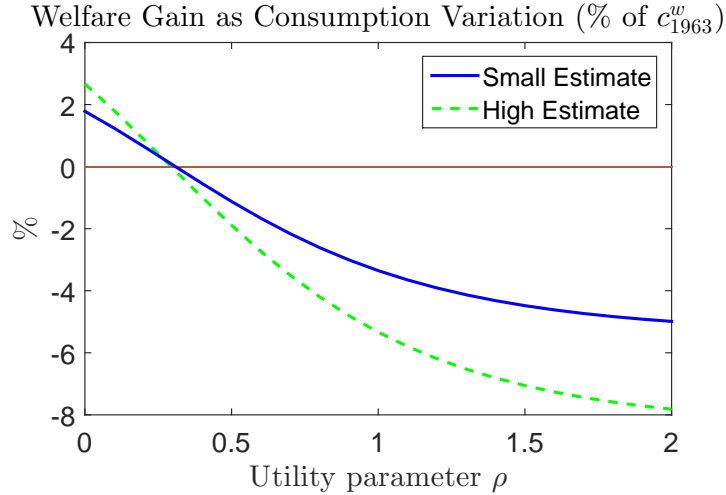
Figure 13: Counterfactual 2 - Initially High Market Power vs. Benchmark.

Note: The figure shows the fixed quantity of consumption which workers would need to get in each period 1963-2003 in order to compensate them for staying in the benchmark economy instead of the counterfactual. This consumption variation is measured relative to worker consumption in 1963 (in the benchmark economy). The solid blue line shows results using the 'small estimate', that is, the coefficient for $C_t^s(\hat{\sigma})$ from column (2) in Table 2. The dashed green line shows results using the 'high estimate', that is, the coefficient from column (1) in Table 2.

7. Conclusion

In this paper, we show that an increase in market power raises growth in the presence of binding financial constraints. We test our model predictions employing rarely used census data from the Korean manufacturing sector 1963-2003. We find that the labor share is lower in more concentrated sectors. These sectors also grow faster. Both the empirical results and our parametrized model imply that the positive relationship between concentration and growth gets weaker over time as credit becomes more abundant. Using a model-based counterfactual, we find that the initial rise and subsequent fall of concentration in Korea has increased manufacturing value added 1963-2003 by at least 0.6 percentage points per year. But we also find that higher growth through increased market power is not always welfare improving.

It is this latter result which naturally raises the question of the optimal level of market power. A policy maker can influence market power through setting entry barriers or antitrust policies. In the presence of binding financial constraints, choosing the optimal level of market power is a non-trivial problem as it involves a trade-off between static losses and dynamic gains. Proposition 4.5 suggests that the optimal Ramsey policy will be path-dependent and time-varying. Poor countries with underdeveloped financial markets will benefit more from high market power than rich economies with well-functioning financial markets. Increases in A_t and λ_t raise the elasticity of growth with respect to changes in market power. We leave the formal study of optimal market power for future research.

A. Proofs and Derivations

Proof of Lemma 4.1

We know that in equilibrium capitalists' budget constraint (8) must be binding. Combining the flow budget constraints of periods $t, t+1, ..., T$, we derive:

$$c_t^{k*} + \sum_{i=1}^{T} \frac{c_{t+i}^{k*}}{\Pi_{j=1}^{i} R_{t+j}} = a_t R_t - \frac{a_{t+T+1}^*}{\Pi_{j=1}^{T} R_{t+j}} \,.$$

Optimality implies that $\lim_{T\to\infty} \frac{a_{t+T+1}^*}{\Pi_{j=1}^{T} R_{t+j}}$ cannot be strictly positive. The No-Ponzi condition (9) implies that it cannot be strictly negative either. It follows that in equilibrium:

$$\sum_{i=0}^{\infty} \frac{c_{t+i}^{k*}}{\Pi_{j=0}^{i} R_{t+j}} = a_t \,. \tag{28}$$

The optimal savings decision must also satisfy the Euler equation period-by-period: $c_{t+1}^{k*} = \beta R_{t+1} c_t^{k*}$. Combining this equation for periods $t+1, t+2, ..., t+T$ yields: $c_{t+T}^{k*} = \beta^T \Pi_{j=1}^{T} (R_{t+j}) c_t^{k*}$. Substituting this into (28) gives: $c_t^{k*} = (1-\beta) a_t R_t$.

Proof of Lemma 4.2

All firms are identical: $N_t = (Z_t - 1) n_t^*$. It follows from (18):

$$(1-\alpha) A_t \left(\frac{k_t}{n_t^*}\right)^\alpha = \gamma(Z_t + 1) n_t^* \,. \tag{29}$$

In equilibrium, each firm demands:

$$n_t^* = \left[\frac{(1-\alpha) A_t}{\gamma(Z_t+1)}\right]^{\frac{1}{1+\alpha}} k_t^{\frac{\alpha}{1+\alpha}} \,. \tag{30}$$

Combining this with market clearing yields for the equilibrium wage w_t^*:

$$w_t^* = \gamma l_t^* = \gamma Z_t n_t^* = \gamma Z_t \left[\frac{(1-\alpha) A_t}{\gamma(Z_t+1)}\right]^{\frac{1}{1+\alpha}} k_t^{\frac{\alpha}{1+\alpha}} \,. \tag{31}$$

Conditional on k_t, equilibrium earnings are:

$$\pi_t^* = A_t k_t^{\frac{2\alpha}{1+\alpha}} \left[\frac{(1-\alpha) A_t}{\gamma(Z_t+1)}\right]^{\frac{1-\alpha}{1+\alpha}} - \gamma Z_t k_t^{\frac{2\alpha}{1+\alpha}} \left[\frac{(1-\alpha) A_t}{\gamma(Z_t+1)}\right]^{\frac{2}{1+\alpha}} - \delta k_t - r(k_t - e_t) \tag{32}$$

$$= A_t^{\frac{2}{1+\alpha}} k_t^{\frac{2\alpha}{1+\alpha}} \left(\frac{1}{\gamma}\right)^{\frac{1-\alpha}{1+\alpha}} \left[\left(\frac{1-\alpha}{Z_t+1}\right)^{\frac{1-\alpha}{1+\alpha}} - Z_t \left(\frac{1-\alpha}{Z_t+1}\right)^{\frac{2}{1+\alpha}}\right] - \delta k_t - r(k_t - e_t) \,. \tag{33}$$

It follows:

$$\pi_t^* = A_t^{\frac{2}{1+\alpha}} k_t^{\frac{2\alpha}{1+\alpha}} \left(\frac{1-\alpha}{\gamma}\right)^{\frac{1-\alpha}{1+\alpha}} \frac{1+\alpha Z_t}{(Z_t+1)^{\frac{2}{1+\alpha}}} - \delta k_t - r\left(k_t - \frac{a_t}{Z_t}\right). \tag{34}$$

We can distinguish two cases: (1.) firms are borrowing-constrained, or (2.) the borrowing constraint is slack.

1. Firms are borrowing-constrained: $k_t = (1+\lambda_t)e_t$. In this case, we have $k_t = (1+\lambda_t)a_t/Z_t$. It follows for w_t^*:

$$w_t^* = \left(\frac{Z_t}{Z_t+1} A_t (1-\alpha)\right)^{\frac{1}{1+\alpha}} [\gamma(1+\lambda_t) a_t]^{\frac{\alpha}{1+\alpha}}. \tag{35}$$

The equilibrium wage w_t^* is strictly increasing in Z_t. Aggregate firm earnings are:

$$Z_t \pi_t^* = A_t^{\frac{2}{1+\alpha}} [(1+\lambda_t)a_t]^{\frac{2\alpha}{1+\alpha}} \left(\frac{1-\alpha}{\gamma}\right)^{\frac{1-\alpha}{1+\alpha}} \frac{1+\alpha Z_t}{Z_t} \left(\frac{Z_t}{Z_t+1}\right)^{\frac{2}{1+\alpha}} - a_t[\delta(1+\lambda_t) + \lambda_t r]. \tag{36}$$

Aggregate firm earnings change with Z_t according to:

$$\frac{\partial Z_t \pi_t^*}{\partial Z_t} = A_t^{\frac{2}{1+\alpha}} [(1+\lambda_t)a_t]^{\frac{2\alpha}{1+\alpha}} \left(\frac{1-\alpha}{\gamma}\right)^{\frac{1-\alpha}{1+\alpha}} \left(\frac{Z_t}{Z_t+1}\right)^{\frac{2}{1+\alpha}} \frac{1}{Z_t^2} \frac{(1-\alpha)(1-Z_t)}{(1+\alpha)(1+Z_t)}. \tag{37}$$

Since $Z_t > 1$, this expression is strictly negative.

2. The borrowing constraint is slack: $k_t = k_t^*$. We know from (17):

$$k_t^* = \left(\frac{\alpha A_t}{r+\delta}\right)^{\frac{1}{1-\alpha}} n_t^*. \tag{38}$$

Combining this with (30) yields:

$$n_t^* = \frac{(1-\alpha)A_t}{\gamma(Z_t+1)} \left(\frac{\alpha A_t}{r+\delta}\right)^{\frac{\alpha}{1-\alpha}}. \tag{39}$$

The equilibrium wage is:

$$w_t^* = \frac{Z_t}{Z_t+1} (1-\alpha) A_t \left(\frac{\alpha A_t}{r+\delta}\right)^{\frac{\alpha}{1-\alpha}}. \tag{40}$$

Again, the equilibrium wage w_t^* is strictly increasing in Z_t. Aggregate firm earnings

are:

$$Z_t\pi_t^* = A_t^{\frac{2}{1-\alpha}} \left(\frac{\alpha}{r+\delta}\right)^{\frac{2\alpha}{1-\alpha}} \frac{(1-\alpha)^2}{\gamma} \frac{Z_t}{(Z_t+1)^2} + a_t r\,. \tag{41}$$

Since $Z_t > 1$, aggregate firm earnings are strictly falling in Z_t:

$$\frac{\partial Z_t\pi_t^*}{\partial Z_t} = A_t^{\frac{2}{1-\alpha}} \left(\frac{\alpha}{r+\delta}\right)^{\frac{2\alpha}{1-\alpha}} \frac{(1-\alpha)^2}{\gamma} \frac{(-Z_t^2+1)}{(Z_t+1)^4} < 0\,. \tag{42}$$

Proof of Proposition 4.3

If borrowing constraints are binding, aggregate output today is:

$$Z_t y_t^* = A_t^{\frac{2}{1+\alpha}} [(1+\lambda_t)a_t]^{\frac{2\alpha}{1+\alpha}} \left(\frac{1-\alpha}{\gamma}\right)^{\frac{1-\alpha}{1+\alpha}} \left(\frac{Z_t}{Z_t+1}\right)^{\frac{1-\alpha}{1+\alpha}}\,. \tag{43}$$

If borrowing constraints are slack, aggregate output today is:

$$Z_t y_t^* = A_t \left(\frac{\alpha A_t}{r+\delta}\right)^{\frac{2\alpha}{1-\alpha}} \frac{(1-\alpha)A_t}{\gamma} \frac{Z_t}{Z_t+1}\,. \tag{44}$$

In both cases, aggregate output is strictly increasing in Z_t. Employment today is: $l_t^* = w_t^*/\gamma$. Since we know from the proof of Lemma 4.2 that w_t^* is increasing in Z_t, it follows that also l_t^* and $c_t^{w^*}$ increase in Z_t.

Now consider the effect of an increase in Z_t on the equilibrium in some future period $t+j$ in which firms' borrowing constraint is binding. Aggregate output is:

$$Z_{t+j} y_{t+j}^* = A_{t+j}^{\frac{2}{1+\alpha}} [(1+\lambda_{t+j})a_{t+j}]^{\frac{2\alpha}{1+\alpha}} \left(\frac{1-\alpha}{\gamma}\right)^{\frac{1-\alpha}{1+\alpha}} \left(\frac{Z_{t+j}}{Z_{t+j}+1}\right)^{\frac{1-\alpha}{1+\alpha}}\,. \tag{45}$$

We know from (10) that: $a_{t+1} = \beta(a_t + Z_t\pi_t)$. Iterating forward yields:

$$a_{t+j} = \beta^j a_t + \sum_{\tau=0}^{j-1} \beta^{j-\tau} Z_{t+\tau}\pi_{t+\tau} \quad , \text{for } j = 1, 2, \dots \tag{46}$$

Since by Lemma 4.2, aggregate firm earnings $Z_t\pi_t$ are falling in Z_t, so is future aggregate firm equity a_{t+j}. Since aggregate output $Z_{t+j}y_{t+j}^*$ is strictly increasing in a_{t+j} if borrowing constraints are binding, $Z_{t+j}y_{t+j}^*$ is falling in Z_t. From (35), it follows that also w_{t+j}^*, l_{t+j}^*, and $c_{t+j}^{w^*}$ are falling in Z_t.

Proof of Proposition 4.4

Now consider the effect of an increase in Z_t on the equilibrium in period $t + j$ if firms are unconstrained. Aggregate output in period $t + j$ is:

$$Z_{t+j} y^*_{t+j} = A_{t+j} \left(\frac{\alpha A_{t+j}}{r + \delta} \right)^{\frac{2\alpha}{1-\alpha}} \frac{(1-\alpha)A_{t+j}}{\gamma} \frac{Z_{t+j}}{Z_{t+j} + 1} . \tag{47}$$

This is independent of Z_t and a_{t+j}. There is no effect of a change in Z_t on $Z_{t+j} y^*_{t+j}$. The same is true for w^*_{t+j}, l^*_{t+j}, and c^{w*}_{t+j}.

Proof of Proposition 4.5

The ratio of credit to output is:

$$\frac{d^*_t}{y^*_t} = \frac{a_t \lambda_t}{Z_t y^*_t} . \tag{48}$$

The numerator is linear in a_t and λ_t. We know from equation (43) that the denominator is concave in a_t and λ_t. It follows that a rise in a_t increases the ratio of credit to output. Only the denominator rises in A_t. It follows that the credit-to-output ratio falls in A_t.

Consider now the elasticity of aggregate output tomorrow $Z_{t+1} y^*_{t+1}$ with respect to Z_t:

$$\epsilon = \left| \frac{Z_t}{Z_{t+1} y^*_{t+1}} \frac{\partial Z_{t+1} y^*_{t+1}}{\partial Z_t} \right| = \left| \frac{Z_t}{Z_{t+1} y^*_{t+1}} \frac{\partial Z_{t+1} y^*_{t+1}}{\partial a_{t+1}} \frac{\partial a_{t+1}}{\partial Z_t} \right| = \left| \frac{2\alpha}{1+\alpha} \frac{Z_t}{a_{t+1}} \frac{\partial a_{t+1}}{\partial Z_t} \right| . \tag{49}$$

It follows:

$$\epsilon = \left| \frac{2\alpha}{1+\alpha} \frac{Z_t}{a_t + Z_t \pi_t} \frac{\partial Z_t \pi_t}{\partial Z_t} \right| = \left| \frac{\frac{2\alpha}{1+\alpha} \left(\frac{Z_t}{Z_t+1} \right)^{\frac{2}{1+\alpha}} \frac{1}{Z_t} \frac{(1-\alpha)(1-Z_t)}{(1+\alpha)(1+Z_t)}}{\frac{1+\alpha Z_t}{Z_t} \left(\frac{Z_t}{Z_t+1} \right)^{\frac{2}{1+\alpha}} + a_t^{\frac{1-\alpha}{1+\alpha}} \frac{1 - \delta(1+\lambda_t) - \lambda_t r}{A_t^{\frac{2}{1+\alpha}} (1+\lambda_t)^{\frac{2\alpha}{1+\alpha}} \left(\frac{1-\alpha}{\gamma} \right)^{\frac{1-\alpha}{1+\alpha}}}} \right| . \tag{50}$$

Accordingly, an increase in a_t (or a fall in A_t or λ_t) lowers ϵ if and only if: $1 > \delta(1 + \lambda_t) + \lambda_t r$.

B. Pareto Distribution

A Pareto distribution implies for the probability that a plant has more than x workers:

$$\Pr[X \geq x] = \begin{cases} \left(\frac{x_m}{x} \right)^{\sigma} & \text{if } x \geq x_m, \\ 1 & \text{otherwise}, \end{cases} \tag{51}$$

where $x_m > 0$ is the minimum value of X and $\sigma > 0$. For $x \geq x_m$, the probability density of the establishment size is:

$$\varphi(x) = \left(\frac{x_m}{x}\right)^{\sigma} \frac{\sigma}{x} . \tag{52}$$

Accordingly, the share of total employment in establishments above size x and below x_u is:

$$\mathrm{W}(x) \;=\; \frac{\int_x^{x_u} \left(\frac{x_m}{x}\right)^{\sigma} \frac{\sigma}{x} \, x \, dx}{\int_{x_m}^{x_u} \left(\frac{x_m}{x}\right)^{\sigma} \frac{\sigma}{x} \, x \, dx} \;=\; \frac{\int_x^{x_u} x^{-\sigma} dx}{\int_{x_m}^{x_u} x^{-\sigma} dx} \;=\; \frac{x_u^{1-\sigma} - x^{1-\sigma}}{x_u^{1-\sigma} - x_m^{1-\sigma}} . \tag{53}$$

C. Herfindahl-Hirschman Index

In general, the Herfindahl-Hirschman Index is defined as:

$$HHI_t^s = \sum_{i=1}^{I} \left(ms_{it}^s\right)^2 , \tag{54}$$

where i indicates an individual establishment and ms_{it} is the market share of establishment i at time t. Since we are interested in the labor market, we measure an establishment's market share by its share of total sector employment e_t^s: $ms_{it}^s = e_{it}/e_t^s$, where e_{it} is establishment i's number of workers. Unfortunately, we do not observe e_{it}. However, we know the market share of any given establishment with employment x: $ms_t^s(x) = x/e_t^s$. This allows us to calculate the following Herfindahl-Hirschman Index based on our estimate $\hat{\sigma}$ for the different establishment size distributions:

$$HHI_t^s = \int_{x_m}^{x_u} \left(ms_t^s(x)\right)^2 \left[\varphi(x) \times z_t^s\right] dx = \frac{z_t^s}{(e_t^s)^2} \, x_m^{\hat{\sigma}} \, \frac{\hat{\sigma}}{2 - \hat{\sigma}} \left[x_u^{2-\hat{\sigma}} - x_m^{2-\hat{\sigma}}\right] , \tag{55}$$

where z_t^s is the total number of establishments in sector s at time t.

D. Robustness: Market Power and Growth

In columns (1) and (3) of Table 5 in the appendix, we regress *changes* in sector growth on *changes* in concentration. Since we do not control for financial development, we can include time-fixed effects. As always, we include sector-fixed effects and we cluster standard errors by sectors. We see that changes in $C_t^s(\hat{\sigma})$ have a positive and significant relationship with changes in growth. The Herfindahl-Hirschman Index is not significant when we do not control for financial development.

In columns (2) and (4), we repeat the regressions from Table 3 in first differences. Since we control for financial development, we use a linear time trend instead of time-fixed effect here. We find a positive and significant coefficient for concentration (both $C_t^s(\hat{\sigma})$ and $HHI_t^s(\hat{\sigma})$). The positive relationship between concentration and growth gets

Table 5: Market Power and Growth in First Differences.

	(1) ΔG_t^s	(2) ΔG_t^s	(3) ΔG_t^s	(4) ΔG_t^s
$\Delta C_t^s(\hat{\sigma})$	0.524**	1.574***		
	(4.15)	(7.34)		
ΔCredit/GDP		-0.408**		-0.0890
		(-4.15)		(-0.89)
$\Delta C_t^s(\hat{\sigma})$*Credit/GDP		-1.94**		
		(-3.55)		
ΔE_t^s	0.884**	0.773***	0.823*	0.711***
	(3.93)	(5.90)	(3.19)	(5.95)
Year		0.0146**		0.00331
		(3.80)		(1.08)
$\Delta HHI_t^s(\hat{\sigma})$			-0.0637	19.85**
			(-0.33)	(3.74)
$\Delta HHI_t^s(\hat{\sigma})$*Credit/GDP				-56.5**
				(-3.84)
R^2	0.82	0.62	0.75	0.42
R^2 (FE only)	0.57	0.01	0.57	0.01
N	64	64	64	64

R^2 (FE only) is the R^2 of a fixed-effects regression without control variables (columns (1) and (3)), and of a sector-fixed-effects regression with a time trend and without control variables (columns (2) and (4)). t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

weaker as credit becomes more abundant.

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