Financial Frictions and Non-Balanced Growth

[Very Preliminary]

Joaquin Blaum*
Brown University

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Abstract

I document two facts on the pattern of cross-industry growth rates: (i) externally dependent sectors tend to grow faster along the economy's development path, and (ii) externally dependent sectors grow disproportionately faster in countries with better financial institutions. I argue that financial frictions can account for these facts. I build a dynamic two-sector model in which sectors differ in their liquidity requirement. I assume that agents are heterogeneous in their wealth holdings and face collateral constraints. I show that without the friction in the capital market the economy exhibits balanced growth along the transition to the steady state. Financial frictions distort the distribution of firm size and generate faster growth in the sector with higher liquidity requirement along the economy's development path. I then find conditions under which financial development leads to higher excess growth in the externally dependent sector.

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1 Introduction

The process of economic development is typically characterized by uneven rates of growth across sectors. The traditional literature, starting with Clark (1940) and Kuznets (1957), documents the change in the relative importance of major sectors - notably agriculture, manufacturing and services - along the development path of the economy. Several explanations have been put forward to account for this pattern of non-balanced growth. One group of theories has focused on differences in income elasticities across goods (Kongsamut, Rebelo, and Xie (2001), Foellmi and Zweimuller (2008)). Other theories have emphasized supply-side reasons for non-balanced growth. Baumol (1967) and Ngai and Pissarides (2007) propose biased productivity growth, while Acemoglu and Guerrieri (2008) posit differences in factor proportions across sectors together with capital deepening.

In this paper, I provide evidence for an alternative form of non-balanced growth and propose a novel theory to account for it. On the empirical side, I show that sectors that rely more heavily on external finance exhibit faster output growth along the economy's development path. I also show that externally dependent sectors grow disproportionately faster in countries with better financial institutions. On the theory side, I argue that frictions in financial markets can account for both of these facts. I build a dynamic two-sector model where sectors differ in their liquidity requirements and agents are heterogeneous in their wealth holdings and face collateral constraints. In the model, non-balanced growth is a result of the financial friction. I show that the model can account for the documented faster output growth of externally dependent sectors and, under some conditions, for the disproportionate effect of financial development on industry growth rates of these sectors.

I use a panel of 69 countries over 26 years to document two facts on the pattern of industrial growth rates. First, I show that externally dependent sectors tend to grow at a faster rate along the economy's development path. Second, I show that externally dependent sectors grow disproportionately faster in financially developed countries.[1] The second fact is a variant of the main finding of Rajan and Zingales (1998). The first fact is, to the extent of my knowledge, a novel characteristic of the process of industrial development. I establish this fact at two different levels of sectoral aggregation. First, I divide manufacturing industries into two groups according to their external financial dependence and show that increases in a country's real per capita income are associated with increases in relative output of the more externally dependent sectors. Second, exploiting the fully disaggregated sectoral data, I use a difference in difference strategy to show that increases in a country's growth rate of real per capita income are associated with increases in industry growth rates that are more pronounced for externally dependent sectors.

To jointly account for these facts, I propose a two-sector growth model whose main ingredient is the presence of financial market imperfections. In the model, there is a continuum of producer-consumer agents who differ in their wealth holdings. Agents need to decide in which of the two

[1] Alternatively, these facts can be expressed as follows. Consider the growth differential, defined as the output growth rate of high external dependence sector minus the growth rate of low external dependence sectors. Fact 1 states that the growth differential is positive. Fact 2 states that the growth differential is increasing in the country's level of financial development.

sectors to operate. The two sectors have identical technologies, except for a liquidity requirement that differs across sectors. Absent financial frictions, the economy exhibits balanced growth in its transition to the steady state. I then introduce a financial friction that affects the agents' ability to enter the more liquidity intensive sector. In particular, only agents with wealth greater than some threshold are able to enter this sector. When the the mass of agents with wealth above this threshold is small enough, the economy is constrained and the optimal size of production units is distorted. As long as financial frictions bind, the liquidity-intensive sector grows faster than the other sector. The reason is that, as the economy develops, the agents are able to gradually overcome the friction in financial markets and migrate from the unconstrained to the constrained sector. Thus, financial frictions are a source of non-balanced growth via an extensive margin channel.

In this framework, it is not granted that an improvement in financial development leads to disproportionately higher growth in the more externally dependent sector.[2] The degree of excess growth of the liquidity-intensive sector depends crucially on the speed at which agents overcome financial constraints, as well as on the specific shape of the wealth distribution. Under the assumption of a constant savings rate, I find sufficient conditions on the wealth distribution and the parameters of the model under which financial development leads to disproportionately higher growth in the liquidity intensive sector. These conditions require that the savings rate, and the interest rate, must both be sufficiently low. A low interest rate means that the economy needs to be sufficiently constrained or, in other words, financial frictions need to be sufficiently high.

When financial frictions are not sufficiently high, financial development leads to a reduction in the degree of excess growth in externally dependent sectors. Eventually, for a sufficiently low degree of financial frictions, financial development has no effect on the growth differential. Thus, the model predicts an inverted U-shaped relationship between the level of financial development and the growth differential. I show that this prediction of the model is supported by the data.

Related Literature. Seminal empirical contributions to the literature on structural change - Clark (1940), Kuznets (1957), Chenery (1960), Syrquin and Chenery (1975) - provide evidence for the hypothesis that, along an economy's process of development, there is substantial reallocation of resources and output between major sectors.[3] In particular, these authors document a decrease in the importance of the agriculture sector and an increase in the importance of the manufacturing and services sectors, both in terms of employment and product shares, as countries develop. In this paper, I look at the change in the relative importance of different industries *within* the Manufacturing sector, focusing on the degree of external financial dependence as the industry characteristic of interest. Thus, I provide evidence for a different kind of structural change.

On the methodological front, most of the previous empirical work on structural change builds on cross-country comparisons of average sectoral value added or employment shares, where the time dimension has been reduced to obtain a single observation per country - see Kuznets (1957) and

[2] In other words, the model is not consistent with Fact 2 and the main finding of Rajan and Zingales (1998) for all parameters.

[3] For a recent survey on structural change, see Matsuyama (2008).

Chenery (1960).[4] Notable exceptions are Syrquin and Chenery (1975, 1989) who use panel data to regress various sectoral variables on income per capita and total population, allowing for country and some form of time fixed effects.[5] In this paper, I propose an alternative methodology to study structural change, namely the difference in difference strategy pioneered by Rajan and Zingales (1998). Specifically, by focusing on explanatory variables that vary with country, sector and time - i.e. an interaction term between the country's growth rate in real per capita income and the sector's external dependence - I am able to include country, sector and time fixed effects.

The paper is also related to the theoretical literature on structural change. Most of the theories that have been put forward to account for non-balanced growth fall into either of two categories: demand or supply-side explanations. In the former, sectors with higher income elasticity become relatively more important as the economy develops - see Kongsamut, Rebelo, and Xie (2001) for a prominent example. In the latter class of theories, non-balanced growth follows from either differential productivity growth (Ngai and Pissarides (2007)) or factor-proportion differences (Acemoglu and Guerrieri (2008)) across sectors. In this paper, I propose a third category: frictions to trade in financial markets. In my theory, as in Acemoglu and Guerrieri (2008), technology differs across sectors but, absent financial frictions, the economy exhibits balanced growth. In this sense, non-balanced growth is a direct consequence of the friction in the market for capital.

2 Empirical Evidence

In this section, I document two facts on the pattern of cross-industry growth rates. First, I show that sectors that rely more heavily on external finance exhibit faster output growth along the economy's development path. Second, I show that externally dependent sectors grow disproportionately faster in countries with better financial institutions. I establish these facts using a panel of 69 countries for 26 years, with data for 15 manufacturing sectors per country.

I provide evidence for the faster output growth of externally dependent sectors along the economy's development path - henceforth Fact 1- on two levels of sectoral aggregation. First, at the country level, I study the evolution of the ratio of output in high external dependence sectors to output in low external dependence sectors. I show that relative output in externally dependent sectors tends to co-move with real per capita income over time. Second, at the country-sector level, I show that growth in a country's real per capita income is associated with disproportionately higher industry output growth in externally dependent sectors. Thus, the evidence suggests that economic development, as measured by growth in real per capita income, is accompanied by faster growth of externally dependent sectors.

[4] Kuznets (1957) presents two forms of descriptive statistics: (a) an international comparison of value added and employment shares of major sectors, where each country's share is a 5-year average, and (b) a longer-term analysis for fewer countries, where he shows time-averages for different subperiods, for each country. Chenery (1960) runs cross-country regressions of sectoral value added shares on income per capita and total population. The time dimension is eliminated by taking time-averages.

[5] More recently, Kongsamut, Rebelo, and Xie (1997) regress sectoral labor shares on income per capita, but do not include country nor time fixed effects.

I provide evidence for the positive effect of financial development on the degree of excess output growth of externally dependent sectors - henceforth Fact 2 - by following the strategy in Rajan and Zingales (1998). Specifically, I consider a cross-section of industry output growth rates between 1980 and 1989. I show that higher initial financial development is associated with higher subsequent output growth, and the effect is stronger for sectors that are more externally dependent.

Data Sources

I use data on value added and quantity indices of industrial production from the Industrial Statistics Yearbook, compiled by the United Nations Statistical Division (1993) - henceforth UNSD. The UNSD provides data for a wide cross section of countries and industries between 1967 and 1991.

Data on financial development is obtained from Beck, Demirgüç-Kunt, and Levine (2000). I focus on two measures of financial development: (i) the ratio of private credit by deposit money banks and other financial institutions to GDP, and (ii) the ratio of stock market capitalization to GDP. The first measure is constructed with raw data from the IMF's *International Financial Statistics*, while the second measure uses data from Standard and Poor's *Emerging Market Database* and *Emerging Stock Market Factbook*.

Data on real income per capita is taken from Penn World Tables. In particular, I use the chain series of PPP converted GDP per capita, at 2005 constant prices.

Data on external dependence for the 3-digit ISIC sectors during the 1980s is taken from Rajan and Zingales (1998) - henceforth RZ. They use firm-level data on publicly traded US firms from Compustat (1994) and measure a firm's dependence on external finance as the fraction of capital expenditures that is not financed with internal cashflows from operations.

The final sample consists of 69 countries, which are listed in Table 5 in the Appendix.

Fact 1: Growth in real per capita income is associated with faster output growth in externally dependent sectors

In this subsection, I show that overall development of the economy, as measured by growth in real per capita income, is characterized by faster output growth in externally dependent sectors. I provide evidence for this fact on two levels. First, at the country level, I show that relative output in externally dependent sectors tends to co-move with real per capita income. Second, at the country-sector level, I show that increases in a country's growth rate of real per capita income are associated with increases in industry output growth rates that are more pronounced for externally dependent sectors.

I start by dividing manufacturing industries into two groups according to their degree of external financial dependence. For each group, I compute a weighted average of the industrial production indices of the corresponding sectors in the group. I weight each index of industrial production by the sector's value added share within the group.[6] Let $\bar{Q}_{mkt}$ be the average index of industrial production

[6]More specifically, let Q_{jkt} and VA_{jkt} be the index of industrial production and value added, respectively, in sector

in group $m \in \{L, H\}$, in country k at time t. I then define relative output in externally dependent sectors as $\bar{Q}_{Hkt}/\bar{Q}_{Lkt}$.

To get a visual sense of Fact 1, Figures 1 and 2 show the evolution of this ratio for 12 countries in the sample between 1967 and 1991. Additionally, the Figures show the evolution of real per capita income for each country. A clear pattern emerges: in periods when real per capita income tends to grow, relative output in externally dependent sectors also tends to grow; in periods when real per capita income tends to fall, relative output also tends to fall. In other words, real per capita income and relative output in externally dependent sectors tend to co-move, over time and for each country.

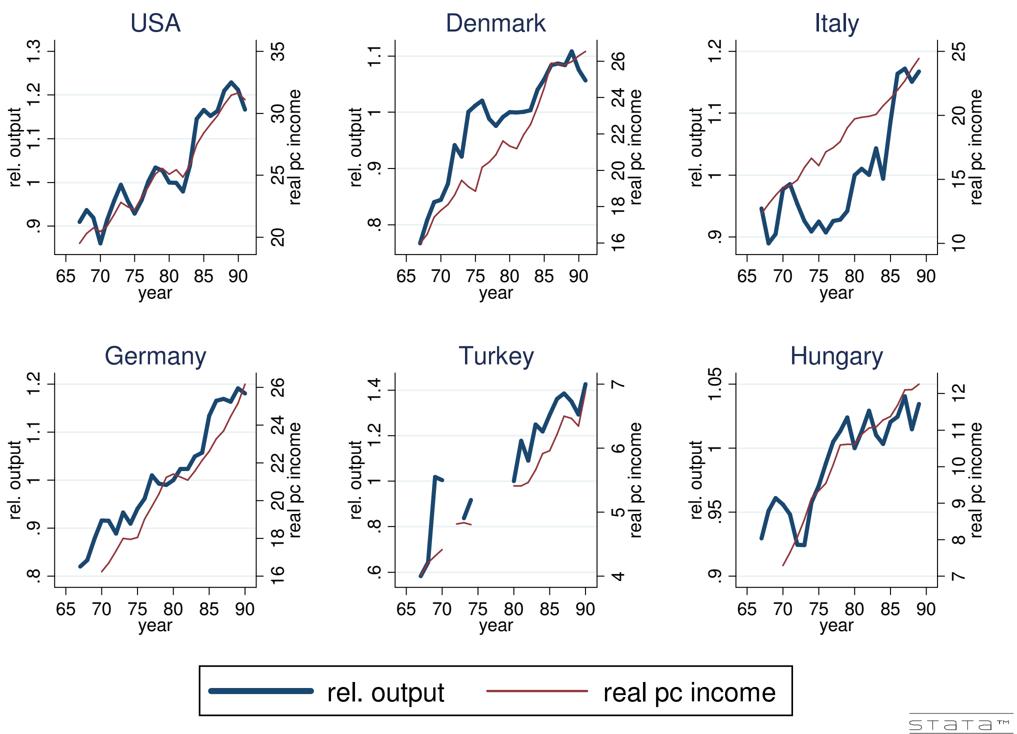

Figure 1: Relative Output in Externally Dependent Sectors, 1967-1991, Selected Countries

Next, I evaluate whether the pattern suggested by Figures 1 and 2 holds in the entire sample. Using the panel of 69 countries and 26 years per country, I test whether increases in real per capita income are associated with increases in relative output in externally dependent sectors. To do so, I

j of country k at time t. Then, the average index in group $m \in \{L, H\}$ is constructed as:

$$\bar{Q}_{mkt} = \sum_{j \in m} \frac{VA_{jkt}}{\sum_{j \in m} VA_{jkt}} Q_{jkt}$$

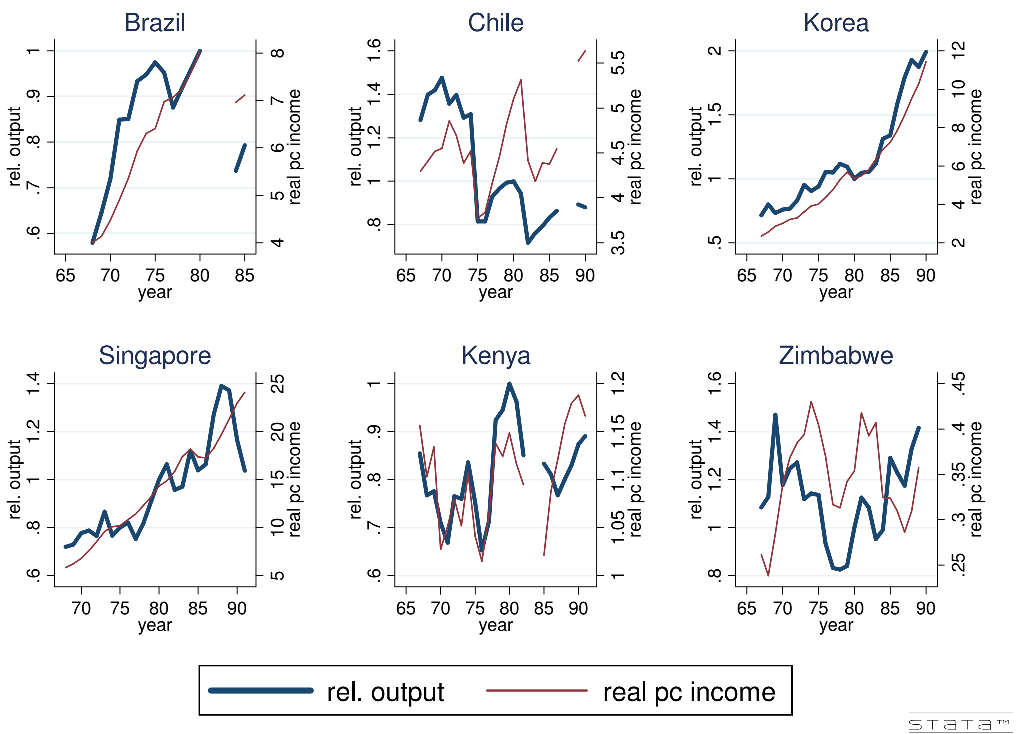

Figure 2: Relative Output in Externally Dependent Sectors, 1967-1991, Selected Countries

run the following specification at the country level:

$$\bar{Q}_{Hkt}/\bar{Q}_{Lkt} = \alpha + \alpha_k + \alpha_t + \beta_1 RGDP_{kt} + \varepsilon_{jkt},$$

where $RGDP_{kt}$ denotes real per capita GDP in country k at time t, and α_k and α_t denote country and sector fixed effects, respectively. Table 1 contains the results. We see that real per capita GDP is positively associated with relative output in externally dependent industries. This suggests that economic development, as captured by growth in real income per capita, is accompanied by a bias in industrial production towards sectors that rely more heavily in external finance.

Dep. var.	Relative Output in Externally Dependent Sectors	
	(1)	(2)
Real Per Capita GDP	0.0245***	0.0227***
	(0.0024)	(0.0039)
Country FE	Y	Y
Time FE	N	Y
Observations	1,113	1,113
R2	0.4757	0.4931

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. The dependent variable is the ratio of average output in high external dependence industries to average output in low external dependence industries. Index numbers of industrial production and value added at sector level are taken from the Industrial Statistics Yearbook compiled by the United Nations Statistics Division. The analysis is restricted to manufacturing sectors. Sectors are classified into high and low external financial dependence using the notion developed by Rajan and Zingales (1998). The coefficients estimates and standard errors were multiplied by 1000.

Table 1: Non-Balanced Growth: Relative Output in Externally Dependent Sectors

Finally, I show that this pattern is not an artifact of the aggregation into two sectors but is also present at the country-sector level. To see this, I run the following specification:

$$g_{jkt} = \alpha + \alpha_j + \alpha_k + \alpha_t + \beta_1 G_{kt} + \beta_2 G_{kt} ed_j + \varepsilon_{kt},$$

where g_{jkt} is the annual growth rate in the industrial production index of sector j in country k at time t, G_{kt} is the annual growth rate in real per capita GDP in country k at time t, and ed_j is the degree of external financial dependence of sector j. Table 2 contains the results. The positive and significant coefficient estimate for G_{kt} captures the mechanical relation between the country's overall performance and output growth in manufacturing industries. The positive and significant coefficient estimate for the interaction term captures the non-balanced nature of economic growth. Increases in the rate of growth of a country's real per capita income are associated with increases in output growth of manufacturing industries, and these increases are more pronounced for externally dependent sectors.

Dep. var.	Industry Output Growth		
	(1)	(2)	(3)
Growth Rate	0.7140***	0.5826***	0.6255***
	(0.0416)	(0.0427)	(0.0449)
Growth Rate x Ext Dep	0.8810***	0.8806***	0.6889***
	(0.0951)	(0.0921)	(0.1142)
Country FE	Y	Y	Y
Time FE	N	Y	Y
Sector FE	N	N	Y
Observations	17,719	17,719	17,719
R2	0.1500	0.1692	0.1782

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. The dependent variable is the growth rate in the quantity index of industrial production at the sector level. 'Growth rate' stands for the yearly growth rate in real per capita GDP at the country level. 'Ext Dep' stands for the industry's degree of external financial dependence, as constructed by Rajan and Zingales (1998). Index numbers of industrial production are taken from the Industrial Statistics Yearbook compiled by the United Nations Statistics Division. The analysis is restricted to manufacturing sectors. Data for real per capital GDP is taken from Penn World Tables.

Table 2: Non-Balanced Growth: Industry Growth Rates

Fact 2: Financial development is associated with disproportionately faster output growth in externally dependent sectors

In this subsection, I show that industrial sectors that are relatively more in need of external finance grow disproportionately faster in countries with more developed financial institutions. To do so, I use the difference-in-difference methodology of Rajan and Zingales (1998), which consists of estimating the following specification:

$$g_{jk} = \alpha + \alpha_j + \alpha_k + \beta ed_j \lambda_k + \varepsilon_{jk}, \tag{1}$$

where g_{jk} is the annual compounded rate of growth in output in sector j in country k for the period 1980-1989 and λ_k is a measure of country k's financial development. The advantage of this approach is the inclusion of sector and country fixed effects, which helps alleviate potential bias from omitted sector-specific and country-specific variables.

Table 3 contains the results. Column (1) uses the ratio of private credit to GDP while column (2) uses the ratio of stock market capitalization to GDP as a measure of the country's level of financial development. In both cases, the coefficient estimate for the interaction term comes out positive and significant. This indicates that financial development is associated with disproportionately higher output growth in externally dependent industries.

The estimated coefficients imply that the industry at the 75th percentile of external dependence should grow 0.48 percentage points faster than the industry at the 25th level when it is located in a country at the 75th percentile of financial development rather than in one at the 25th percentile. For comparison, the rate of growth in industry output is about 2 percent per year, on average.

Dep. var.	Annual Growth Rate in Output	
	(1)	(2)
Ext Dep x Priv Credit	0.0313**	
	(0.0146)	
Ext Dep x MktCap		0.0264**
		(0.0108)
Country and Sector FE	Y	Y
Observations	1053	815
R2	0.4174	0.5263
Differential in Real Growth	0.4835	0.4476

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. All regressions include country and industry fixed effects. The dependent variable is the annual compounded growth rate in output for the period 1980-1989 for each ISIC industry in each country. The variable "Ext dep" is a measure of the industry's level of external financial development, as constructed by Rajan and Zingales (1998). The variable "Priv Credit" stands for the ratio of private credit by deposit money banks and other financial institutions to GDP. "MktCap" stands for the ratio of stock market capitalization to GDP. Both financial development measures are taken from Beck, Demirgüç-Kunt, and Levine (2000). The differential in real growth measures how much faster an industry at the 75th percentile level of external dependence grows with respect to an industry at the 25th percentile level when it is located in a country at the 75th percentile of financial development rather than in one at the 25th percentile.

Table 3: Financial Development and Industry Growth

Note that the results in Table 3 do not imply that external financial dependence is associated with faster output growth. A positive coefficient on the interaction term in equation (1) means that financial development is associated with an increase in the degree of *excess* growth in externally dependent sectors. It does not mean that such excess growth is positive, i.e. that externally dependent sectors grow faster. This latter feature was established in the previous subsection - see Fact 1.

There are two important differences between the results contained in Table 3 and the ones in Rajan and Zingales (1998). First, I focus on growth in fixed-price quantity indices while RZ focus on growth in value added. Second, RZ control for the industry's share in manufacturing value added in 1980 while I exclude this variable from the analysis.

3 A Model of Frictions to Entry

In this section, I propose a theory based on financial frictions to explain the facts documented above. In particular, I explore a two-sector Solow growth model in which liquidity is required to start production and sectors differ in their liquidity requirements. I study financial frictions that hinder the ability of agents to gather liquidity and therefore enter the liquidity-intensive sector. I show that, absent financial frictions, the economy exhibits balanced growth along the transition to the steady state. With frictions in financial markets, the liquidity intensive sector grows faster as the economy develops. This happens because agents gradually overcome the friction in financial markets and migrate from the low to the high-liquidity intensive sector, giving the latter an extra source of growth. Thus, in this theory, non-balanced growth emerges as a consequence of financial frictions.

The model delivers the positive co-movement between real per capita GDP and relative output in externally dependent sectors documented in Fact 1 of the previous Section. Along the economy's development path, both variables tend to grow. I also study the effect of financial development on the differential of growth rates across sectors. I find conditions on the distribution of wealth and other parameters such that financial development leads to a disproportionate increase in the growth rate of the liquidity-intensive sector, as documented in Fact 2 of the previous Section. In general, the model predicts an inverted U-shaped relationship between financial development and the degree of excess growth in the liquidity intensive sector. I show that this prediction is supported by the data.

3.1 Basic Environment

Consider a dynamic economy with three sectors: a final good and two intermediate inputs. The final good can be either consumed or used as capital to produce intermediates. The intermediate inputs, which are non-storable, are used for the production of the final good.

There is a unit mass of producer-consumer entrepreneurs who are endowed with physical capital, or wealth, and labor. I assume that all agents are endowed with one unit of time and that initial wealth is the only source of heterogeneity across agents. I denote initial wealth by ω_0 and its distribution by $G_0(\omega_0)$. The dynamic behavior of entrepreneurs is characterized by a linear savings rule: in each period, agents consume a fraction $1 - s$ of their end-of-period wealth, where $s \in (0, 1)$.

The final good is produced with the following production function:

$$y = y_1^{\gamma_1} y_2^{\gamma_2}$$

where y_i denotes the amount of intermediate good $i = 1, 2$ used in final good production. I assume that the final good technology is subject to decreasing returns, i.e. $\gamma_1 + \gamma_2 < 1$.

The two intermediate inputs are produced with the following technology: $f_i(k) = A_i k^{\alpha}$ for $i = 1, 2$, where $\alpha \in (0, 1)$, A_i is sector-specific productivity, and k denotes units of capital used. Sector 2 further requires a fixed amount of resources, $f > 0$ units of the final good, to start production. These resources are not actually used as capital in the production process. Thus, f can be interpreted as a liquidity requirement and sector 2 as more *liquidity intensive* than sector 1.[7]

Finally, I assume that production of the final good is done by a single external firm whose profits are equally distributed to all entrepreneurs. That is, entrepreneurs cannot enter the final good sector. This assumption simplifies the analysis, as entrepreneurs need only decide between two sectors instead of three.

At the beginning of the period, agents choose an intermediate sector to operate a firm. Then, a market for capital meets where agents trade claims on two types of loans: (i) loans destined to cover the liquidity requirement and (ii) loans for working capital. The first type of agreements is done between entrepreneurs and an external agent who offers liquidity at no cost.[8] However, trades of this type are subject to a friction: an agent with wealth ω cannot borrow more than $\lambda\omega$ from the external agent, where $\lambda \geq 1$ is a parameter that captures the degree of financial development of the economy. The second type of agreements consists of loan contracts between entrepreneurs, in which units of the final good are exchanged for the duration of the period at an interest rate of r. There are no frictions for this type of loans.

The particular form of financial friction assumed results in a very simple reduced form friction: only agents with wealth $\omega \geq f/\lambda$ can enter into sector 2. Conditional on entry, capital markets are perfect: all agents are borrow and lend as much as desired. Thus, this model focuses on the bite that financial frictions have in restricting entry into sectors which require more liquidity for production.

3.2 Equilibrium

In this section, I study the behavior of entrepreneurs and the final good firm, and define the equilibrium. The next two sections characterize the equilibrium and establish the main results of the paper.

Problem of entrepreneurs. Entrepreneurs' (static) production decisions are dissociated from their (dynamic) consumption/savings decisions. As producers they decide in which intermediate sector to operate and how much output to produce (and thus how much capital to use). As consumers, they decide how much of the final good (i.e. capital) to consume and how much to save for next period. Let's first study their static production problem. Conditional on entry into sector i, all agents are identical and solve the following problem:

$$\pi_i^* = \max_{k_i} p_i A_i k_i^\alpha - (r+\delta)k_i = (\alpha^{-1}-1)\left(\frac{\alpha A_i p_i}{(r+\delta)^\alpha}\right)^{\frac{1}{1-\alpha}} \tag{2}$$

[7] To simplify the characterization of the equilibrium in the next section, I further assume that the resources used to meet the liquidity requirement are immediately available for an alternative use after entry into sector 2. In other words, entrepreneurs are able to immediately lend the resources used for liquidity purposes and earn interest on them.

[8] The assumption that liquidity loans entail no interest is done for simplicity. Technically, interest payments on these loans are negligible since the funds are needed only for an instant of time.

where the optimal scale of the firm is given by

$$k_i^* = \left(\frac{\alpha A_i p_i}{r+\delta}\right)^{\frac{1}{1-\alpha}}$$

Entrepreneurs with wealth $\omega < f/\lambda$ have no choice but to go to sector 1. Entrepreneurs with wealth $\omega \geq f/\lambda$ can enter into either sector and will choose the one with highest profits. Thus, assuming that all capital is borrowed, profits from production are:

$$\pi(\omega; p_1, p_2, r) = max\left\{\pi_1^*, I(\omega \geq f/\lambda)\pi_2^*\right\},$$

where $I(\omega \geq f/\lambda)$ is an indicator function that takes the value of 1 when $\omega \geq f/\lambda$.

After production is done, agents save a constant fraction s of their end-of-period wealth, so that the law of motion for wealth is:

$$\omega_{t+1} = s(1+r_t)\omega_t + s\max\left\{\pi_{1t}^*, I(\omega_t \geq f/\lambda)\pi_{2t}^*\right\} + s\pi_{FGt}^*, \tag{3}$$

where π_{FG}^* are the rebated profits from the final good firm. I now specify the problem of the final good firm. Recall that I have assumed that all production of the final good is done by a single firm.

Problem of final good firm. The firm operating in the final good sector solves the following problem:

$$\pi_{FG}^* = \max_{y_1, y_2} y_1^{\gamma_1} y_2^{\gamma_2} - p_1 y_1 - p_2 y_2 = (1-\gamma_1-\gamma_2)\left(\frac{\gamma_1^{\gamma_1}\gamma_2^{\gamma_2}}{p_1^{\gamma_1}p_2^{\gamma_2}}\right)^{\frac{1}{1-\gamma_1-\gamma_2}}, \tag{4}$$

where I have normalized the price of the final good to unity. This problem yields input demands given by:

$$y_1^* = \left(\frac{\gamma_1^{1-\gamma_2}\gamma_2^{\gamma_2}}{p_1^{1-\gamma_2}p_2^{\gamma_2}}\right)^{\frac{1}{1-\gamma_1-\gamma_2}}$$

$$y_2^* = \left(\frac{\gamma_1^{\gamma_1}\gamma_2^{1-\gamma_1}}{p_1^{\gamma_1}p_2^{1-\gamma_1}}\right)^{\frac{1}{1-\gamma_1-\gamma_2}}$$

I now define the equilibrium of this economy. Given the assumption of perfect capital markets after entry, a key equilibrium object is the mass of agents allocated to sector 1 at time t, which I denote by μ_t.

Definition 1. Definition. Given an initial distribution of wealth $G_0(\omega)$, a competitive equilibrium is a sequence of prices $\{p_{1t}, p_{2t}, r_t\}_{t=0}^{\infty}$, allocation of agents $\{\mu_t\}_{t=0}^{\infty}$, and a sequence of wealth distributions $\{G_{t+1}(\omega)\}_{t=0}^{\infty}$ such that

1. Given prices p_{1t}, p_{2t}, r_t, static production decisions are done optimally, that is, π_{1t}^*, π_{2t}^* and π_{FGt}^* satisfy (2) for i=1,2 and (4), respectively.

2. Markets clear at every period t:

    (a) Capital market:

$$\mu_t \left(\frac{\alpha A_1 p_{1t}}{r_t + \delta}\right)^{\frac{1}{1-\alpha}} + (1-\mu_t)\left(\frac{\alpha A_2 p_{2t}}{r_t + \delta}\right)^{\frac{1}{1-\alpha}} = \mathbb{E}[G_t(\omega)] \tag{5}$$

    (b) Intermediate good 1:

$$\left(\frac{\gamma_1^{1-\gamma_2}\gamma_2^{\gamma_2}}{p_1^{1-\gamma_2}p_2^{\gamma_2}}\right)^{\frac{1}{1-\gamma_1-\gamma_2}} = \mu_t A_1 \left(\frac{\alpha A_1 p_{1t}}{r_t + \delta}\right)^{\frac{\alpha}{1-\alpha}} \tag{6}$$

    (c) Intermediate good 2:

$$\left(\frac{\gamma_1^{\gamma_1}\gamma_2^{1-\gamma_1}}{p_1^{\gamma_1}p_2^{1-\gamma_1}}\right)^{\frac{1}{1-\gamma_1-\gamma_2}} = (1-\mu_t) A_2 \left(\frac{\alpha A_2 p_{2t}}{r_t + \delta}\right)^{\frac{\alpha}{1-\alpha}} \tag{7}$$

    (d) Either:

        i. $A_1 p_{1t} = A_2 p_{2t}$ and $\mu_t \geq G_t(f/\lambda)$ (unconstrained static equilibrium)
        ii. $A_1 p_{1t} < A_2 p_{2t}$ and $\mu_t = G_t(f/\lambda)$ (constrained static equilibrium)

3. The distribution of wealth evolves according to

$$G_{t+1}(\omega) = \int_{\{z:\omega_{t+1}(z)\leq\omega\}} dG_t(z)$$

    where $\omega_{t+1}(z)$ is given by (3).

The constraint that agents need to be above a wealth threshold f/λ to enter sector 2 translates into an aggregate constraint that the mass of agents allocated to sector 2 in equilibrium cannot exceed the mass of agents whose wealth is above the threshold, that is $1 - \mu_t \leq 1 - G_t(f/\lambda)$, or simply $\mu_t \geq G_t(f/\lambda)$. Given $(\mathbb{E}[G_t(\omega)], G_t(f/\lambda))$, market clearing conditions and either profit equalization or the binding aggregate constraint pin down current prices and the allocation of agents to sectors, $\{p_{1t}, p_{2t}, r_t, \mu_t\}$. Note that the pair $(\mathbb{E}[G_t(\omega)], G_t(f/\lambda))$ resembles a pair of "moments" of the wealth distribution, where the second "moment" is affected by the parameter of financial development and the fixed cost.

3.3 Non-Balanced Growth

In this section, I establish a central result of the paper, namely, that financial frictions are a source of non-balanced growth across sectors. To do so, I first characterize the static equilibrium, i.e. the equilibrium for a given distribution of wealth. In particular, I obtain expressions for output in the different sectors as a function of aggregate wealth and the mass of agents with wealth below the threshold. I then show that, in a transition path where financial frictions bind and the mass of constrained agents decreases, output in the liquidity-intensive sector grows relatively faster. At the same time, average wealth increases over time. Thus, the model is consistent with the documented positive co-movement between real per capita GDP and relative output in the externally dependent sector - see Fact 1 of the previous section.

I start by defining a *static* equilibrium as an equilibrium given $\mathbb{E}[G_t(\omega)]$ and $G_t(f/\lambda)$). From now on, I denote by x_t the mass of agents with wealth lower than the threshold, i.e. $x_t \equiv G_t(f/\lambda)$. The static equilibrium is *unconstrained* whenever:

$$\frac{\gamma_1}{\gamma_1+\gamma_2} \geq x_t \tag{8}$$

Claim 1. In an *unconstrained static equilibrium*, the following properties hold:

1. The share of agents assigned to sector 1 is given by:

$$\mu_t = \frac{\gamma_1}{\gamma_1+\gamma_2}$$

2. Entrepreneurs achieve the first-best scale in both sectors:

$$k_{1t} = k_{2t} = \mathbb{E}[G_t(\omega)]$$

3. Profits are equalized across sectors, $A_1 p_{1t} = A_2 p_{2t}$

4. All prices, p_{1t}, p_{2t} and r_t are decreasing in mean wealth, $\mathbb{E}[G_t(\omega)]$.

5. Sectoral output levels are given by:

$$Q_{1t} = \frac{\gamma_1}{\gamma_1+\gamma_2} A_1 \mathbb{E}[G_t(\omega)]^{\alpha} \tag{9}$$

$$Q_{2t} = \frac{\gamma_2}{\gamma_1+\gamma_2} A_2 \mathbb{E}[G_t(\omega)]^{\alpha}$$

See Appendix for a proof. Thus, when the mass of agents with wealth above the threshold is large enough, the production side of the economy is as in the frictionless economy. Note that x_t is irrelevant when (8) holds.

When condition (8) fails to hold, we have a *constrained* static equilibrium and the mass of agents allocated to sector 2 is as high as possible:

$$\mu_t = G_t(f/\lambda)$$

Claim 2. In an *constrained static equilibrium*, the following properties hold:

1. The share of agents assigned to sector 1 is larger than the optimal:

$$\mu_t = x_t > \frac{\gamma_1}{\gamma_1 + \gamma_2} \tag{10}$$

2. Firm size is distorted. In particular, sector 1 is smaller and sector 2 is larger when compared to their respective first best values:

$$k_{1t} = \frac{\gamma_1}{\gamma_1 + \gamma_2} \frac{\mathbb{E}[G_t(\omega)]}{x_t} < E[G_t(\omega)]$$

$$k_{2t} = \frac{\gamma_2}{\gamma_1 + \gamma_2} \frac{\mathbb{E}[G_t(\omega)]}{1 - x_t} > E[G_t(\omega)]$$

3. Sector 2 exhibits higher profits, $A_2 p_{2t} > A_1 p_{1t}$.

4. All prices $p_{1t},\ p_{2t}$ and r_t are decreasing in mean wealth $\mathbb{E}[G_t(\omega)]$. Furthermore, p_{1t} is decreasing in x_t, p_{2t} is increasing in x_t, and r_t is decreasing in x_t. Comparing these prices to their first best levels, we have that p_{2t} is larger, p_{1t} is smaller, and r_t is smaller.[9] Finally, profits in sector 1 and the final good sector are decreasing in x_t, while profits in sector 2 are increasing in x_t.

5. Sectoral outputs are given by:

$$Q_1 = A_1 \left(\frac{\gamma_1}{\gamma_1 + \gamma_2} \mathbb{E}[G_t(\omega)] \right)^{\alpha} x_t^{1-\alpha} \tag{11}$$

$$Q_2 = A_2 \left(\frac{\gamma_2}{\gamma_1 + \gamma_2} \mathbb{E}[G_t(\omega)] \right)^{\alpha} (1 - x_t)^{1-\alpha} \tag{12}$$

Note that aggregate production at the sector level turns out to be a Cobb-Douglas production function on total capital and labor assigned to the sector. We can use Claims 1 and 2 to preview the dynamic behavior of the economy, by studying the effects of exogenous changes in the two relevant "moments" of the distribution of wealth on the static allocation. Claim 1 implies that, when the friction in financial markets does not bind, the economy exhibits balanced growth across sectors along its development path. Claim 2 implies that, when the friction binds, the economy exhibits *non-balanced growth* along its development path. The following proposition contains these results.

Claim 1. **Proposition 1**. When financial frictions do not bind, the two intermediate sectors grow at the same rate, equal to the rate of growth of average wealth. When financial frictions bind and the mass of agents with wealth below the threshold changes over time, the economy exhibits non-balanced growth across sectors. In particular, negative growth in the mass of agents with wealth below the threshold leads to faster output growth in sector 2 relative to sector 1.

[9] Consistent with other models with frictions in the capital market, the constrained static equilibrium features a *depressed* interest rate.

Proof. **Proof**. The proof relies on Claims 1 and 2. Consider how the quantities produced in the static equilibrium react to exogenous changes in the two moments of the wealth distribution. Applying a total differential to equation (9), sectoral growth rates when financial frictions do not bind are:

$$g_1 = g_2 = \alpha g \tag{13}$$

where g_i is the growth rate of Q_i, and g is the growth rate of average wealth. Applying a total differential to equation (11), sectoral growth rates when financial frictions bind are:

$$g_1 = \alpha g + (1-\alpha) g_x \text{ and } g_2 = \alpha g - (1-\alpha)\frac{x}{1-x} g_x \tag{14}$$

where g_x is the growth rate of the mass of agents with wealth below the threshold. The degree of excess growth in sector 2 is:

$$\Delta g \equiv g_2 - g_1 = -(1-\alpha)\frac{g_x}{1-x} \tag{15}$$

It follows that $g_x \neq 0$ implies $\Delta g \neq 0$, i.e. non-balanced growth. Furthermore, $sign(\Delta g) = -sign(g_x)$ ■

□

Proposition 1 establishes that financial frictions are a source of non-balanced growth across sectors. A natural case to consider is a development path in which aggregate wealth increases and the mass of agents with wealth below the threshold decreases over time.[10] I will refer to these transitional dynamics as a *typical development path.* Proposition 1 establishes that along a typical development path with binding financial frictions output sector 2 grows faster than output in sector 1. At the same time, the increase in aggregate wealth and the reduction in the mass of constrained agents imply that real per capita GDP increases along a typical development path. Thus, the model predicts a positive co-movement between real per capita GDP and relative output in the liquidity-intensive sector along a typical development path. To relate this prediction to Fact 1 of the previous section, we need to assess whether sector 2 is indeed the more externally dependent sector when financial frictions bind.

In turns out that, in the constrained static equilibrium, the liquidity-intensive sector is not necessarily the more externally dependent sector. This is because both capital expenditures and aggregate wealth are higher in this sector. The next subsection derives a condition under which sector 2 is more externally dependent. This condition takes the form of a stronger version of equation (10), the condition that ensures that financial frictions bind in the static equilibrium.

External financial dependence. In order to map the model to the data, we need a notion of external financial dependence in the model. In the data, the degree of external financial dependence is computed as the fraction of capital expenditures that is not financed with internal cashflows. Internal cashflows are used to capture the amount of internal resources that the firm can spend on

[10]This model features no growth in the steady state. To reconcile the model with the fact that most countries exhibit non-zero growth rates, we need to assume that in reality countries are transitioning to their steady states.

inputs without resorting to credit. Thus, the corresponding notion of internal cashflows in the model is given by the amount of wealth held by the entrepreneur running the firm. In this way, firm $\omega's$ degree of external financial dependence, when operating in sector i, is:

$$efd_i(\omega) = \frac{k_i - \omega}{k_i} = 1 - \frac{\omega}{k_i}$$

The average degree of external financial dependence in each sector is then given by:

$$EFD_1 = 1 - \frac{\int_{\{\omega<f/\lambda\}} \omega dG(\omega)}{\mu k_1} \text{ and } EFD_2 = 1 - \frac{\int_{\{\omega\geq f/\lambda\}} \omega dG(\omega)}{(1-\mu)k_2}$$

Thus, the condition for sector 2 to be more externally dependent is:

$$\int_{\{\omega\geq f/\lambda\}} \omega dG(\omega) < \frac{\gamma_2}{\gamma_1} \int_{\{\omega<f/\lambda\}} \omega dG(\omega) \tag{16}$$

This condition requires that the group of agents in sector 2 holds a sufficiently small fraction of total wealth or that γ_2/γ_1 is high enough. Intuitively, sector 2 is more externally dependent if the firms in this sector have few internal resources (i.e. wealth) and/or if capital expenditures are relatively large in this sector (high γ_2/γ_1). It turns out that, as long as there is some degree of inequality in the distribution of wealth, condition (16) is stronger than condition (10).

Claim 3 . When the Lorenz curve of $G(\omega)$ is below the line of perfect equality at $\omega = f/\lambda$, then condition (16) implies condition (10).

See the Appendix for a proof. Intuitively, (16) requires that the fraction of total wealth held by the group of agents in sector 1 is sufficiently large. When the distribution of wealth is not perfectly egalitarian, the fraction of agents in group 1 is always larger than the fraction of wealth they have.

To summarize, if the economy is constrained along a typical development path, in the sense that condition (16) holds, then the model predicts the positive co-movement between real per capita GDP and relative output in externally dependent sectors observed in the data - see Fact 1 of the previous section.

3.4 The Effects of Financial Development

In this section, I study the effect of financial development on cross-sector output growth rates. In particular, I identify conditions under which the model is able to come to terms with Fact 2 of the previous section, namely, the positive effect of financial development on the degree of excess output growth of externally dependent sectors.

The assumption of a constant savings rate implies that I can obtain closed-form expressions for sector-level output growth rates between any two consecutive periods, as functions of the distribution of wealth in the first of the two periods and parameters. In this way, I can bypass the computation of the entire transition to the steady state, and simply focus on any two consecutive periods.[11]

[11] It should be noted that the steady state of this economy depends on initial conditions. This is due to the presence

In what follows, I define the *growth differential* to be the degree of excess growth in the liquidity-intensive sector. When considering discrete periods of time, it is convenient to work with the following measure of the growth differential, namely the ratio of gross growth in sector 2 to gross growth in sector 1:

$$rg \equiv \frac{1+g_2}{1+g_1}$$

where g_i is the rate of growth of output in sector $i = 1, 2$ between two consecutive periods.

When the economy is unconstrained in the two consecutive periods, it follows from Claim 1 that sectoral growth rates are given by:

$$1+g_i = \left(\frac{\mathbb{E}[G_{t+1}(\omega)]}{\mathbb{E}[G_t(\omega)]}\right)^{\alpha}$$

Thus, both sectors grow at the same rate, which is a function of the growth rate of aggregate capital. It follows that in this case financial development has no effect on the growth differential.[12]

When the economy is constrained in at least the first of the two consecutive periods, financial development has an effect on the growth differential.[13] For example, when financial frictions bind in both periods, the growth differential is given by:

$$rg = \left(\frac{1-x_{t+1}}{x_{t+1}} / \frac{1-x_t}{x_t}\right)^{1-\alpha} = \left(\frac{\tilde{x}_{t+1}}{\tilde{x}_t}\right)^{1-\alpha} \tag{17}$$

where $\tilde{x}_t \equiv (1-x_t)/x_t$ is the *relative* mass of agents whose wealth is above the threshold. Along a typical development path, we have $\tilde{x}_{t+1} \geq \tilde{x}_t$, so that the economy exhibits non-balanced growth in favor of sector 2, i.e. $rg \geq 1$, as established in Proposition 1 above. Since both $\tilde{x}_{t+1}$ and $\tilde{x}_t$ increase with λ, the effect of financial development on the growth differential depends on which of these two effects is stronger. The following Proposition deals with this situation.

Proposition 2. (Financial Development, I) Consider an economy that is constrained in both periods $t = 0$ and $t = 1$, with $x_0 \geq x_1$. Define w_1 as

$$w_1 \equiv \frac{\frac{f}{s\lambda} - \pi_1^* - \pi_{FG}^*}{1+r} \tag{18}$$

where π_1^*, π_{FG}^* and r are profits in sector 1, profits in the final good sector and the interest rate at $t = 0$. Denote by $G(\omega)$ the CDF and by $g(\omega)$ the PDF of the $t = 0$ distribution of wealth. Under

of a technological non-convexity together with financial market frictions, as in Galor and Zeira (1993). Depending on initial conditions, the economy converges either to a first best, unconstrained steady state where all agents have identical wealth, or to a constrained steady state in which the distribution of wealth has mass on two points - a low level of wealth associated with operating in sector 1 and a high level of wealth associated with operating in sector 2. For more details on the steady state, see Section 5.5 in the Appendix.

[12] This is because if at the initial λ the economy is unconstrained in both periods, then at the higher λ the economy is still unconstrained in both periods. Thus, for both levels of λ, the growth differential is equal to unity.

[13] Given the focus on a typical development path, I do not consider the case in which the economy switches from unconstrained to constrained.

the following two conditions:

$$\frac{g(w_1)}{G(w_1)(1-G(w_1))} > \frac{g(f/\lambda)}{G(f/\lambda)(1-G(f/\lambda))} \tag{19}$$

$$s(1+r) \leq 1 \tag{20}$$

an increase in λ leads to an increase in rg.

See Appendix for a proof. Proposition 2 establishes sufficient conditions under which financial development leads to an increase in the growth differential. Recall that, from equation (17), the ratio of sectoral growth rates depends on the ratio of relative mass of agents above the threshold at $t = 1$ to relative mass at $t = 0$. First note that financial development decreases the "effective" threshold f/λ, and thus increases the relative mass of agents above the threshold at t=0, $\tilde{x}_0$. This effect tends to decrease the growth differential, rg. The intuition is that financial development increases entry in sector 2 at $t = 0$, thus increasing output in sector 2 and decreasing output in sector 1 - which for given levels of output in $t = 1$ tends to decrease the growth rate of sector 2 and increase the growth rate of sector 1. However, financial development also affects the equilibrium in period $t = 1$. The decrease in f/λ lowers x_0, which in turn increases the $t = 0$ interest rate (r), profits in sector 1 (π_1^*) and profits in the final good sector (π_{FG}^*). This implies that more agents cross the wealth threshold between $t = 0$ and $t = 1$, and thus x_1 is lower, or equivalently $\tilde{x}_1$ is higher (see (3)). In other words, there is entry into sector 2 and exit out of sector 1 at $t = 1$, which implies that output in sector 2 increases and output in sector 1 decreases. Thus, for given levels of output at $t = 0$, the growth differential increases. The combination of these two effects, that is, the effect on $t = 0$ production levels and on $t = 1$ production levels, means that the qualitative effect of financial development on the growth differential depends on parameters. Conditions (19) and (20) guarantee that the effect on $t = 1$ output levels is stronger than the effect on $t = 0$ output levels.

Let's try to understand the intuition behind these conditions. First note that w_1, defined in the statement of the proposition, is the level of $t = 0$ wealth below which agents are still constrained in period $t = 1$. Thus, we can express the mass of agents below the threshold at $t = 1$ as a function of the distribution of wealth in $t = 0$ and w_1, that is $x_1 = G(w_1)$. Thus, x_0 and x_1 are each determined by a wealth threshold, f/λ and w_1, respectively. The increase in λ reduces x_1 via decreasing w_1. Condition (19) insures that the distribution of wealth is such that the elasticity of $(1 - G(w))/G(w)$ with respect to w is greater at threshold w_1 than at threshold f/λ.[14] Thus, for *the same reduction in these thresholds,* financial development induces a higher increase in entry at $t = 1$ than there is at $t = 0$, thus increasing rg. In addition to this, condition (20) ensures that the decrease in w_1 is larger than the decrease in f/λ, which further reinforces the increase in the growth differential.[15] The

[14]This see this, note that the elasticity of the relative mass of agents above a given point w is given by:

$$\frac{\partial}{\partial w}\left(\frac{1-G(w)}{G(w)}\right)\frac{G(w)}{1-G(w)} = \frac{-g(w)}{(1-G(w))G(w)}$$

[15]It should be noted that condition (20) is also required for the existence of an unconstrained steady state. See

intuition can be seen in partial equilibrium. If prices do not change after the increase in λ, we have that $d(f/\lambda) = s(1+r)dw_1$. When $s(1+r) < 1$, a decrease in f/λ induces an even larger decrease in w_1. This condition holds either when the interest rate is low enough, or when the savings rate is low enough. Since financial frictions depress the equilibrium interest rate, the first case corresponds to sufficiently deteriorated financial institutions (λ low enough).

Finally, it is important to note that condition (19) is satisfied by the Pareto distribution[16], a family that turns out to be a good approximation for the upper tail of the actual distribution of wealth - see PARETO (1897). The uniform distribution also satisfies condition (19), as long as both thresholds are low enough.

I now turn to the case in which the economy is constrained only in the first of the two periods.

Proposition 3. (Financial Development, II) Consider an economy which is constrained in period $t = 0$ and unconstrained in period $t = 1$. In this case, an increase in λ reduces rg.

This proposition follows directly from Claims 1 and 2 which imply that the ratio of growth in sector 2 to growth in sector 1 is given by:

$$rg = \frac{1+g_2}{1+g_1} = \left(\frac{\gamma_2}{\gamma_1}\frac{x_0}{1-x_0}\right)^{1-\alpha} \tag{22}$$

where $x_0 = G_0(f/\lambda)$. Since the economy is constrained in the first period, we have that $x_0 > \gamma_1/(\gamma_1 + \gamma_2)$ which immediately implies $rg > 1$. It follows from equation (22) that financial development, by reducing x_0, reduces the growth differential. The same is true for any change in the wealth distribution $G_0(\omega)$ that reduces x_0.

A numerical example can help summarize the results from Propositions 2 and 3. Figure 3 shows the growth differential, rg, as λ increases, when the distribution of wealth in the first period is Pareto and the conditions of Proposition 2 are initially satisfied.[17] For λ low enough, financial development increases the growth differential, as implied by Proposition 2. For intermediate values of λ the economy is still constrained in the first period but is now unconstrained in the second period. As prescribed by Proposition 3, the growth differential falls with financial development in this range. For λ large enough, the economy is unconstrained in both periods and financial development has no effect on the growth differential, which is constant at unity.

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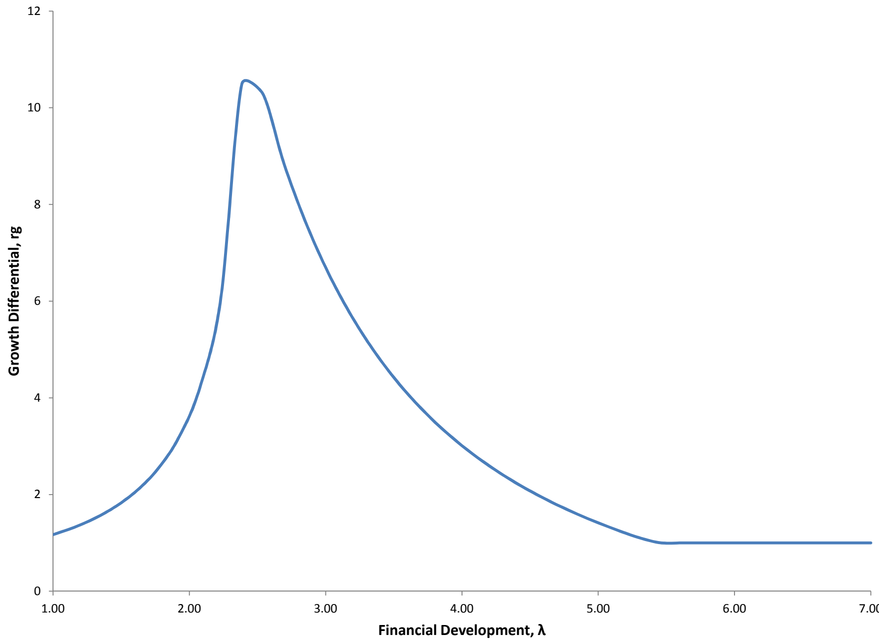
section 5.5 in the Appendix.

[16] Note that, since $f/\lambda > w_1$, condition (19) can be replaced by a stronger condition:

$$\frac{\partial}{\partial w}\left(\frac{g(w)}{(1-G(w))G(w)}\right) < 0 \tag{21}$$

It is straightforward to verify that the Pareto family satisfies this condition.

[17] That is, $G_0(\omega) = 1 - (\omega_{min}/\omega)^{\theta}$.



Notes: The Figure displays the value of the ratio of growth rates, rg, for each of 40 values of λ in the interval [1,7]. The distribution of wealth in the first period is assumed to be Pareto with scale parameter $\omega_{min} = 0.13$ and shape parameter $\theta = 3$. The technological parameters are $\gamma_1 = \gamma_2 = 0.3$, $\alpha = 0.2$, $f = 0.91$, $\delta = 0.058$. The savings rate is $s = 0.89$ and the average capital stock is $\mathbb{E}[G_0(\omega)] = 0.2$.

Figure 3: Financial Development and the Growth Differential

3.5 Testing Model Implications

The model predicts an inverted U-shaped relation between the degree of excess growth in externally dependent sectors and the level of financial development - see Figure 3. In this subsection, I provide evidence in support of this prediction. Table 4 contains the results of estimating equation (1) for subsamples of low, intermediate and high financial development countries. We see that for low financial development countries the effect of financial development on the growth differential is strong and *positive*. Comparing Table 4 with Table 3, which runs the same specification for the full sample, we see that the coefficients on the subsample of low financial development countries are at least three times larger in magnitude. For countries with an intermediate level of financial development, Table 4 shows a *negative* relationship between financial development and the growth differential, as predicted by the theory. Finally, for sufficiently financially developed countries, Table 4 shows no relationship between financial development and excess growth in externally dependent sectors. In short, the data supports the inverted U-shaped relation between financial development and the growth differential predicted by the theory.

	Low Fin. Dev.		Intermediate Fin. Dev.		High Fin. Dev.	
	(1)	(2)	(3)	(4)	(5)	(6)
Ext Dep x Priv Credit	0.0887*		-0.6958*		0.0377	
	(0.0457)		(0.3688)		(0.0316)	
Ext Dep x MktCap		0.2271**		-0.1662*		0.0111
		(0.0976)		(0.1027)		(0.0207)
Country and Sector FE	Y	Y	Y	Y	Y	Y
Observations	579	396	195	182	264	222
R2	0.4183	0.606	0.4869	0.4873	0.605	0.5626

Notes: Robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. All regressions include country and industry fixed effects. The dependent variable is the annual compounded growth rate in output for the period 1980-1989 for each ISIC industry in each country. The variable "Ext dep" is a measure of the industry's level of external financial development, as constructed by Rajan and Zingales (1998). The variable "Priv Credit" stands for the ratio of private credit by deposit money banks and other financial institutions to GDP. "MktCap" stands for the ratio of stock market capitalization to GDP. Both financial development measures are taken from Beck, Demirgüç-Kunt, and Levine (2000). The thresholds to classify countries into the low, intermediate and high financial development groups are the 50th and the 75th percentile of the ratio of private credit (or stock market capitalization) to GDP.

Table 4: Financial Development and Industry Growth: Split Sample

4 Concluding Remarks

In this paper, I provide new evidence of non-balanced growth. Using a panel of 69 countries with 15 manufacturing sectors per country for the period 1967-1991, I show that sectors that rely more heavily on external finance feature faster output growth along the economy's development path. I also show that financial development is associated with disproportionately faster growth in industries that are more intensive in external finance. I argue that financial frictions can account for these two facts. I build a two-sector dynamic model where sectors only differ in their liquidity requirements and financial markets are imperfect. In particular, I focus on frictions that affect the ability of agents' to enter one of the sectors but have no effect on intensive margin decisions. In the model, non-balanced growth emerges as a consequence of the frictions in financial markets. I derive conditions under which financial development leads to a disproportionate increase in the growth rate of the externally dependent sector. In general, the model predicts an inverted U-shaped relation between financial development and the degree of excess growth in the externally dependent sector. I show that this prediction is supported by the data.

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5 Appendix

5.1 Countries in the sample

Algeria	Ethiopia	Korea	South Africa
Australia	Fiji	Luxembourg	Spain
Austria	Finland	Malawi	Sri Lanka
Bangladesh	France	Malaysia	Sweden
Barbados	Germany	Malta	Switzerland
Belgium	Ghana	Mexico	Syrian Arab Republic
Bolivia	Greece	Morocco	Trinidad And Tobago
Brazil	Honduras	Netherlands	Tunisia
Canada	Hungary	Norway	Turkey
Chile	India	Panama	United Kingdom
Colombia	Indonesia	Paraguay	United States
Cote D'Ivoire	Iran	Peru	Uruguay
Cyprus	Ireland	Philippines	Venezuela
Denmark	Israel	Poland	Zambia
Dominican Republic	Italy	Portugal	Zimbabwe
Ecuador	Japan	Romania	
Egypt	Jordan	Senegal	
El Salvador	Kenya	Singapore	

Table 5: Countries in UNSD Data

5.2 Proof of Claim 1

To prove Claim 1 we need to characterize the unconstrained equilibrium, i.e. the equilibrium in which financial frictions do not bind. In this case, agents can freely move between sectors and therefore profits are equalized across sectors - see condition 2(d)i in the equilibrium definition. This implies that $p_1 A_1 = p_2 A_2$, which together the ratio of equations (6) to (7) imply:

$$\frac{\mu}{1-\mu} = \frac{\gamma_1}{\gamma_2}$$

or $\mu = \gamma_1 / (\gamma_1 + \gamma_2)$. Profit equalization implies that the capital market clearing condition (5) becomes:

$$k_i = \left(\frac{\alpha A_i p_i}{r+\delta}\right)^{\frac{1}{1-\alpha}} = \mathbb{E}[G(\omega)] \tag{23}$$

Sectoral outputs are then given by:

$$Q_1 = \mu A_1 \mathbb{E}[G(\omega)]^{\alpha} = \frac{\gamma_1}{\gamma_1+\gamma_2} A_1 \mathbb{E}[G(\omega)]^{\alpha}$$
$$Q_2 = (1-\mu)\, A_2 \mathbb{E}[G(\omega)]^{\alpha} = \frac{\gamma_2}{\gamma_1+\gamma_2} A_1 \mathbb{E}[G(\omega)]^{\alpha}$$

To show that prices are decreasing in mean wealth, we need to derive expressions for p_1, $p_2$and r. Plugging equation (23) into equation (6), and using the profit equalization condition, we obtain:

$$A_i p_i = \frac{\gamma_1^{\gamma_1}\gamma_2^{\gamma_2}(\gamma_1+\gamma_2)^{1-\gamma_1-\gamma_2}A_1^{\gamma_1}A_2^{\gamma_2}}{\mathbb{E}[G(\omega)]^{\alpha(1-\gamma_1-\gamma_2)}} \tag{24}$$

Plugging (24) back into equation (23), we obtain an expression for the interest rate:

$$r = \alpha\frac{\gamma_1^{\gamma_1}\gamma_2^{\gamma_2}(\gamma_1+\gamma_2)^{1-\gamma_1-\gamma_2}A_1^{\gamma_1}A_2^{\gamma_2}}{\mathbb{E}[G(\omega)]^{1-\alpha\gamma_1-\alpha\gamma_2}} - \delta$$

Finally, the condition that $\mu \geq x$, i.e. the aggregate financial constraint, remains to be verified. This condition is satisfied whenever:

$$\frac{\gamma_1}{\gamma_1+\gamma_2} \geq x$$

This concludes the proof. ■

5.3 Proof of Claim 2

When $\frac{\gamma_1}{\gamma_1+\gamma_2} < x$, the allocation derived in the previous subsection cannot be an equilibrium since it violates the aggregate financial constraint that $\mu \geq x$. Instead, the mass of agents in sector 1 is as low as possible, i.e. $\mu = x$. In this case, the capital market clearing condition (5) becomes:

$$x\left(A_1p_1\right)^{\frac{1}{1-\alpha}} + (1-x)\left(A_2p_2\right)^{\frac{1}{1-\alpha}} = \left(\frac{r+\delta}{\alpha}\right)^{\frac{1}{1-\alpha}}\mathbb{E}[G(\omega)] \tag{25}$$

The ratio of equations (6) to (7) pins down the degree to which prices are higher in sector 2:

$$A_2p_2 = \left(\frac{x}{1-x}\frac{\gamma_2}{\gamma_1}\right)^{1-\alpha} A_1p_1 \tag{26}$$

Equations (25) and (26) imply:

$$x\left(\frac{\alpha A_1p_1}{r+\delta}\right)^{\frac{1}{1-\alpha}} = xk_1 = \frac{\gamma_1}{\gamma_1+\gamma_2}\mathbb{E}[G(\omega)] \tag{27}$$

$$(1-x)\left(\frac{\alpha A_2p_2}{r+\delta}\right)^{\frac{1}{1-\alpha}} = (1-x)\,k_2 = \frac{\gamma_2}{\gamma_1+\gamma_2}\mathbb{E}[G(\omega)]$$

It then follows that sectoral outputs are given by the expressions in (11). Finally, to prove point #4 of Claim 2, we need to derive expressions for p_1, p_2, r, π_1^*, $\pi_2^*$and π_{FG}^*. Using equations (27), (26) and (6) we obtain:

$$p_1 = \frac{\gamma_1^{1-\alpha(1-\gamma_1)}\gamma_2^{\alpha\gamma_2}(\gamma_1+\gamma_2)^{\alpha(1-\gamma_1-\gamma_2)}A_2^{\gamma_2}/A_1^{1-\gamma_1}}{\mathbb{E}[G(\omega)]^{\alpha(1-\gamma_1-\gamma_2)}}\frac{(1-x)^{(1-\alpha)\gamma_2}}{x^{(1-\alpha)(1-\gamma_1)}}$$

$$p_2 = \frac{\gamma_1^{\alpha\gamma_1}\gamma_2^{1-\alpha(1-\gamma_2)}(\gamma_1+\gamma_2)^{\alpha(1-\gamma_1-\gamma_2)}A_1^{\gamma_1}/A_2^{1-\gamma_2}}{\mathbb{E}[G(\omega)]^{\alpha(1-\gamma_1-\gamma_2)}}\frac{x^{(1-\alpha)\gamma_1}}{(1-x)^{(1-\alpha)(1-\gamma_2)}}$$

$$r = \alpha\frac{A_1^{\gamma_1}A_2^{\gamma_2}x^{(1-\alpha)\gamma_1}(1-x)^{(1-\alpha)\gamma_2}}{\mathbb{E}[G(\omega)]^{\alpha(1-\gamma_1-\gamma_2)+1-\alpha}}(\gamma_1+\gamma_2)^{\alpha(1-\gamma_1-\gamma_2)+1-\alpha}\gamma_2^{\alpha\gamma_2}\gamma_1^{\alpha\gamma_1} - \delta$$

$$\pi_1^* = (1-\alpha)\frac{\gamma_1^{1+\alpha\gamma_1}\gamma_2^{\alpha\gamma_2}A_2^{\gamma_2}A_1^{\gamma_1}}{(\gamma_1+\gamma_2)^{\alpha(\gamma_1+\gamma_2)}}\frac{(1-x)^{(1-\alpha)\gamma_2}}{x^{1-\gamma_1(1-\alpha)}}\mathbb{E}[G(\omega)]^{\alpha(\gamma_1+\gamma_2)}$$

$$\pi_{FG}^* = (1-\gamma_1-\gamma_2)\frac{\gamma_1^{\alpha\gamma_1}\gamma_2^{\alpha\gamma_2}}{(\gamma_1+\gamma_2)^{\alpha(\gamma_1+\gamma_2)}}A_1^{\gamma_1}A_2^{\gamma_2}x^{\gamma_1(1-\alpha)}(1-x)^{\gamma_2(1-\alpha)}\mathbb{E}[G(\omega)]^{\alpha(\gamma_1+\gamma_2)}$$

Note that $x^{\gamma_1}(1-x)^{\gamma_2}$ is decreasing in x for $x > \frac{\gamma_1}{\gamma_1+\gamma_2}$. ■

5.4 Proof of Claim 3

When the Lorenz curve lies before the line of perfect equality at point $\omega = f/\lambda$ we have that

$$\frac{\int_{\{\omega<f/\lambda\}}\omega dG(\omega)}{\mathbb{E}[G_t(\omega)]} \leq \int_{\{\omega<f/\lambda\}} dG(\omega) = \mu$$

and that

$$\frac{\int_{\{\omega\geq f/\lambda\}}\omega dG(\omega)}{\mathbb{E}[G_t(\omega)]} \geq 1-\mu$$

Then, using condition (16), we have that

$$\frac{1-\mu}{\gamma_2} \leq \frac{1}{\gamma_2}\frac{\int_{\{\omega\geq f/\lambda\}}\omega dG(\omega)}{\mathbb{E}[G_t(\omega)]} < \frac{1}{\gamma_1}\frac{\int_{\{\omega<f/\lambda\}}\omega dG(\omega)}{\mathbb{E}[G_t(\omega)]} \leq \frac{\mu}{\gamma_1}$$

which implies condition (10). ■

5.5 Steady State

The *unconstrained* steady state is characterized by p_u^{ss}, r_u^{ss},$\mathbb{E}[G_u^{ss}(\omega)]$ and ω_u^{ss} satisfying equations (5), (6) and

$$\mathbb{E}[G_u^{ss}(\omega)] = \omega_u^{ss} = \frac{s(\pi_1^*+\pi_{FG}^*)}{1-s(1+r_u^{ss})}$$

The unconstrained stationary wealth distribution, $G_u^{ss}(\omega)$, is degenerated at $\omega = \omega_u^{ss}$.

The *constrained* steady state is characterized by p_{1c}^{ss}, p_{2c}^{ss}, r_c^{ss}, x_c^{ss}, $\mathbb{E}[G_c^{ss}(\omega)]$, ω_p^{ss}, and ω_r^{ss} satisfying equations (5), (6), (7) and

$$\omega_p^{ss} = \frac{s(\pi_1^*+\pi_{FG}^*)}{1-s(1+r_c^{ss})} \text{ and } \omega_r^{ss} = \frac{s(\pi_2^*+\pi_{FG}^*)}{1-s(1+r_c^{ss})}$$

$$\mathbb{E}[G_u^{ss}(\omega)] = x_c^{ss}\omega_p^{ss} + (1-x_c^{ss})\omega_r^{ss}$$

In the constrained steady state, the stationary distribution of wealth, $G_c^{ss}(\omega)$, has mass x_c^{ss} at $\omega = \omega_p^{ss}$

and mass $1-x_c^{ss}$ at $\omega = \omega_r^{ss}$. The fact that the economy is constrained in the long run is a consequence of financial frictions together with the presence of a non-convexity. In this regard, the model is close to Galor and Zeira (1993).

5.6 Proof of Proposition 2

Proof. Equation (17) implies that we need to study how the change in λ affects the ratio $\tilde{x}_1/\tilde{x}_0$. Note first that an increase in λ increases $\tilde{x}_0$:

$$\tilde{x}_0 = \frac{1 - G(f/\lambda)}{G(f/\lambda)}$$

As for $\tilde{x}_1$, this is the relative mass of agents above the wealth threshold at time $t = 1$. The law of motion of wealth is given by

$$\omega_1 = \begin{cases} s(1 + r_0)\omega_0 + s(\pi^*_{1,0} + \pi^*_{FG,0}) & if\ \omega_0 < f/\lambda \\ s(1 + r_0)\omega_0 + s(\pi^*_{2,0} + \pi^*_{FG,0}) & if\ \omega_0 \geq f/\lambda \end{cases}$$

Then it follows that

$$x_1 = Pr(\omega_{t+1} \leq f/\lambda) = Pr(s(1+r_0)\omega_0+s(\pi^*_{1,0}+\pi^*_{FG,0}) \leq f/\lambda) = G(\frac{f/\lambda - s(\pi^*_{1,0} + \pi^*_{FG,0})}{s(1 + r_0)}) = G(w_1)$$

is the mass of agents below the threshold in period 1. We can think of w_1 as the threshold level of wealth at time 0, below which all agents will *still* be constrained in period 1. Note crucially that $r_0, \pi^*_{1,0}$ and $\pi^*_{FG,0}$ are all decreasing functions of x_0, as shown in Claim 3. This means that, by reducing x_0, the increase in λalso reduces x_1.Thus, what happens to the ratio of growth rates will depend on which effect, the decrease in x_0 or the decrease in x_1, is larger. More specifically, the growth differential will increase if $(1 - x_1)/x_1$ increases, in percentage points, by more than $(1 - x_0)/x_0$. Mathematically, we need to take the derivative with respect to λ of the following object

$$rg(\lambda) = \frac{1 - G(\frac{f/\lambda - s(\pi^*_{1,0}+\pi^*_{FG,0})}{s(1+r_0)})}{G(\frac{f/\lambda - s(\pi^*_{1,0}+\pi^*_{FG,0})}{s(1+r_0)})} \frac{G(f/\lambda)}{1 - G(f/\lambda)} \tag{28}$$

where it should be noted that $r_0, \pi^*_{1,0}$ and $\pi^*_{FG,0}$ are all functions of λ (see section 5.2 of the Appendix for the explicit functional forms). Differentiating (28) with respect to λ we get

$$\frac{\partial}{\partial \lambda} rg(\lambda) = -\frac{g(w_1)}{G(w_1)^2} \frac{\partial w_1}{\partial \lambda} \frac{G(f/\lambda)}{1 - G(f/\lambda)} - \frac{1 - G(w_1)}{G(w_1)} \frac{g(f/\lambda)}{(1 - G(f/\lambda))^2} \frac{f}{\lambda^2} \tag{29}$$

We need to show that under conditions (19) and (20), this expression is positive. That is,

$$-\frac{g(w_1)}{G(w_1)(1 - G(w_1))} \frac{\partial w_1}{\partial \lambda} - \frac{g(f/\lambda)}{G(f/\lambda)(1 - G(f/\lambda))} \frac{f}{\lambda^2} > 0 \tag{30}$$

Under condition (19), this boils down to showing

$$\frac{\partial w_1}{\partial \lambda} \leq -\frac{f}{\lambda^2} \tag{31}$$

The LHS is

$$\frac{\partial w_1}{\partial \lambda} = -\frac{f}{\lambda^2}\frac{1}{s(1+r_0)}\left\{1+\lambda\frac{r+\delta}{1+r_0}(1-\alpha)(\frac{\gamma_1}{x}-\frac{\gamma_2}{1-x})\frac{\partial x}{\partial \lambda}\right\} - ... \tag{32}$$

$$-\frac{\left(\pi^*_{1,0}(1-\alpha)\left(\frac{\gamma_1-\frac{1}{1-\alpha}}{x}-\frac{\gamma_2}{1-x}\right)-\frac{\gamma_2(1-\alpha)}{1-x}\pi^*_{FG,0}\right)\frac{\partial x}{\partial \lambda}(1+r)-\left(\pi^*_{1,0}+\pi^*_{FG,0}\right)(1-\alpha)(r+\delta)(\frac{\gamma_1}{x}-\frac{\gamma_2}{1-x})\frac{\partial x}{\partial \lambda}}{(1+r_0)^2}$$

Note that the first term on the RHS of 32 is smaller than or equal to $-f/\lambda^2$, since $s(1+r_0) \leq 1$ by condition (20), and the term in the curly bracket is larger than unity. Thus, it suffices to show that

$$\frac{\left(\pi^*_{1,0}(1-\alpha)\left(\frac{\gamma_1-\frac{1}{1-\alpha}}{x}-\frac{\gamma_2}{1-x}\right)-\frac{\gamma_2(1-\alpha)}{1-x}\pi^*_{FG,0}\right)\frac{\partial x}{\partial \lambda}(1+r)-\left(\pi^*_{1,0}+\pi^*_{FG,0}\right)(1-\alpha)(r+\delta)(\frac{\gamma_1}{x}-\frac{\gamma_2}{1-x})\frac{\partial x}{\partial \lambda}}{(1+r_0)^2} \geq 0 \tag{33}$$

Note that this expression's numerator can be written as

$$\frac{\partial x}{\partial \lambda}(1-\alpha)\left\{\pi^*_{1,0}\left[\left(\frac{\gamma_1-\frac{1}{1-\alpha}}{x}-\frac{\gamma_2}{1-x}\right)(1+r)-(\frac{\gamma_1}{x}-\frac{\gamma_2}{1-x})(r+\delta)\right]\right. \tag{34}$$

$$\left.+\pi^*_{FG,0}\left[-\frac{\gamma_2}{1-x}(1+r)-(\frac{\gamma_1}{x}-\frac{\gamma_2}{1-x})(r+\delta)\right]\right\}$$

Each of the expressions within the brackets is negative. For the first one, note that

$$\left(\frac{\gamma_1-\frac{1}{1-\alpha}}{x}-\frac{\gamma_2}{1-x}\right) < (\frac{\gamma_1}{x}-\frac{\gamma_2}{1-x}) < 0$$

as we have assumed that the equilibrium is constrained and thus $x > \frac{\gamma_1}{\gamma_1+\gamma_2}$. This means that the expression in the curly bracket is negative, which together with $\frac{\partial x}{\partial \lambda} < 0$ implies that the expression in (34) is positive. This proves (33) and concludes the proof.■ □