Adjustment to Target Capital, Finance, and Growth

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Abstract

Does financial development result in capital being reallocated more rapidly to industries where it is most productive? We argue that if this was the case, financially developed countries should see faster growth in industries with investment opportunities due to global demand and productivity shifts. Testing this cross-industry cross-country growth implication requires proxies for (latent) global industry investment opportunities. We show that tests relying only on data from specific (benchmark) countries may yield spurious evidence for or against the hypothesis. We therefore develop an alternative approach that combines benchmark-country proxies with a proxy that does not reflect opportunities specific to a country or level of financial development. Our empirical results yield clear support for the capital reallocation hypothesis.

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1 Introduction

According to an influential conjecture some countries experience faster aggregate productivity growth than others because their high levels of financial development lead to capital being reallocated rapidly to industries with investment opportunities (e.g. Bagehot, 1873; Schumpeter, 1911; Levine 1997 and 2005 reviews the literature). We embed this capital reallocation hypothesis in a multi-industry world equilibrium model to test it with international data on industry value-added growth (there is little international data on industry capital). In our theoretical framework, industries are subject to country-specific as well as global demand and productivity shifts. These shifts are partly anticipated and therefore drive a gap between the capital allocation equalizing expected rates of return across industries (the target capital allocation) and the actual allocation. Positive gaps indicate industries with capital shortfalls (investment opportunities) while negative gaps point to excess capital. If financially developed countries allocate capital more rapidly to industries with shortfalls, they should experience faster value-added growth in industries with global investment opportunities.

Testing this cross-country industry growth implication of the capital reallocation hypothesis requires proxies for latent global investment opportunities. One such proxy turns out to be industry capital growth in a financially developed country like the US. This is because investment in financially developed countries should closely reflect anticipated demand and productivity shifts, which are partly global.

Any proxy for global industry investment opportunities introduces measurement error into the empirical analysis. When proxies are based only on data from a particular country, there is additional noise as industry investment opportunities are partly country specific. Country specific opportunities may therefore lead us to understate the role of financial development for growth in industries with investment opportunities (due to classical measurement error bias). Hence, idiosyncrasies in US industry investment could result in false rejections of the industry growth implications of the capital reallocation hypothesis.

In principle, noise in US proxies (or proxies from any other country) for global industry investment opportunities could also lead to overstate the role of financial development for taking advantage of opportunities. This is because US proxies also reflect productivity and demand shifts that are specific to financially developed countries. To see how this may bias results, consider an example with a financially developed and a financially underdeveloped country. Suppose that all industry demand and technology shifts are either global or financial-development specific. In this case, industry investment opportunities in the financially developed country and in the US will be the same in all states of the world. Covariation between investment opportunities in the financially underdeveloped country and the US, on the other hand, is just driven by global industry shifts. Hence, industry growth in the financially developed country would display stronger covariation with US investment than industry growth in the financially underdeveloped country, even if capital markets worked equally well everywhere. But researchers using only US proxies for global opportunities would (wrongly) conclude that the weaker covariation between US industry investment and industry growth in the financially underdeveloped country is a consequence of slow capital reallocation due to financial underdevelopment.

The example assumes that US industry investment opportunities are a perfect measure of opportunities in financially developed countries. In general, US investment opportunities will be a noisy measure of opportunities in these countries too. This leads to two countervailing biases; attenuation bias due to idiosyncratic noise in US opportunity measures and an upward bias due to US measures yielding a noisier proxy for industry opportunities in financially underdeveloped countries.

This makes it important to check on tests of the industry growth implications of the capital reallocation hypothesis based only on US proxies for global opportunities. We develop an approach that combines a US proxy for global industry investment opportunities with a proxy that does not reflect opportunities specific to a country or level of financial development. Our second proxy is world-average value-added growth by industry controlling for growth not reflecting opportunities in financially underdeveloped countries (or, equivalently, industry growth in a hypothetical, financially developed country subject to world-average demand and technology shifts). To ensure that this proxy does not reflect opportunities specific to the US or a certain level of financial development, we estimate it using data on all countries except the US. Our estimates turn out to have a strong positive effect on US industry capital growth, as one would expect if US investment partly reflected global opportunities.

We can therefore test the cross-country industry growth implication of the capital reallocation hypothesis using a two-stage least-squares approach. The first-stage regression relates actual industry capital growth in a financially developed country (the US) to estimated world-average industry opportunities (excluding the US). The second-stage regression uses global industry investment opportunities (predicted industry capital growth from the first stage) to estimate the effect of financial development on growth in industries with global investment opportunities. (This two-stage approach is preferable to using estimates of world-average opportunities only as these contain sampling error.)

Our empirical results using only the US proxy for global investment opportunities indicate a significantly positive effect of financial development on growth in industries with investment opportunities using data on 28 manufacturing industries in 67 countries during the 1980s. This effect of financial development on growth in industries with investment opportunities becomes larger and statistically stronger when we implement our two-stage least squares approach to focus on industry growth in response to global opportunities. Hence, the approach using only the US proxy for global industry investment opportunities ends up understating the role of financial development for growth in industries with opportunities.

The literature examining the cross-country finance-growth nexus using industry data started with Rajan and Zingales (1998). They detail why a cross-country industry approach can overcome standard concerns with cross-country regressions, like reverse causation, multicollinearity, and omitted variables. Rajan and Zingales also show how the approach can be used to test whether financial development increases aggregate productivity growth by lowering the cost of external funds. They argue that if this were the case, financially developed countries should see faster growth in industries that for technological reasons use external finance intensively.

More generally, Rajan and Zingales' approach allows developing a better understanding of the channels through which financial development affects growth by examining industries where particular channels should be stronger for technological reasons. It has therefore been adopted to examine a variety of other technological characteristics that could lead to industries growing faster in some countries than others (e.g. Beck and Levine, 2002; Claessens and Laeven, 2003; Fisman and Love, 2003; Beck, Demirgüc-Kunt, Laeven, and Levine, 2005; Levine, 2005, surveys the literature). We differ in our focus on the role of financial development in allocating funds quickly to industries that face capital shortfalls because of favorable industry demand or productivity shifts.

Our work is most closely related to Fisman and Love (2004a,b), who emphasize the role of financial development for the speed of inter-industry resource reallocation and test it using industry data. Fisman and Love (2004b) find that industry value-added growth patterns are more closely correlated for country pairs with similar levels of financial development, even when they control for economic development and other factors. Fisman and Love (2004a) test whether countries with high levels of financial development grow faster in industries with global growth opportunities proxied by US sales growth. Their results show that industries with global growth opportunities grow faster in financially developed countries, and that this finding prevails when they control for the external finance intensity of industries.

The main difference with Fisman and Love is that we complement tests of the industry growth implications of the capital reallocation hypothesis based on only US proxies for global opportunities with tests that account for US proxies partly reflecting country (financial development) specific opportunities. We show that this is important because using only US proxies for global opportunities may lead to spurious evidence for or against the industry growth implications of the capital reallocation hypothesis.

A second difference with Fisman and Love is that our focus on the capital reallocation hypothesis leads to proxies for US industry opportunities based on investment rather than sales growth data. Like investment, sales growth reflects anticipated profit opportunities; but unlike investment, sales growth also ends up reflecting unexpected demand and productivity shocks. We show that sales growth could therefore be a nosier measure of investment opportunities than capital growth. This ought to manifest itself empirically in two ways. First, US industry capital growth rather than sales growth should predict industry growth in other countries when both are taken in account. Second, the evidence for the growth implications of the capital reallocation hypothesis should become stronger when we focus on the anticipated global component of US industry sales growth (using our two-stage least squares approach). Both implications receive clear empirical support.

A third difference with Fisman and Love is that we use a theoretical world-equilibrium framework to think about the capital reallocation hypothesis and cross-country industry value-added growth. Our framework takes prices to be endogenous and is therefore explicit about the effect of price adjustments on value-added growth in country-industries where, due to financial underdevelopment, supply does not increase despite rising demand (the country-industry value-added growth data also reflects country-industry price changes as the appropriate deflators are unavailable). The framework is also useful for thinking about the measurement of global industry investment opportunities and about estimation.

Wurgler (2000) tests the capital reallocation hypothesis by examining whether industry investment growth is more closely related to industry value-added growth in financially developed economies. He finds strong evidence that this is the case. Bekaert, Harvey, Lundblad, and Siegel (forthcoming) examine whether countries with growth opportunities see faster aggregate output and investment growth. Country growth opportunities are estimated by combining the country's pattern of industrial specialization with indicators of global industry growth opportunities (proxied by average price-earnings ratios across countries weighted by countries' relative market capitalization). They find that country-level growth opportunities predict output and investment growth, and also that this relation is strongest in countries that have liberalized their capital accounts, equity markets, and banking systems.

The remainder of the paper is structured as follows. Section 2 presents our theoretical framework linking the capital reallocation hypothesis and cross-country industry-level value-added growth. We then use the framework to illustrate the potential biases of using US data (or data from another country) to proxy for global industry investment opportunities and explain how such biases can be avoided with a second proxy for global opportunities. Section 3 describes the sources and main features of the data. Section 4 presents our empirical results. Section 5 summarizes.

2 Theoretical Framework

We develop a multi-industry world equilibrium model to examine the cross-country industry growth implication of the capital reallocation hypothesis and analyze how this implication can be tested.

2.1 Model

The world consists of a continuum of open economies inhabited by households with love-for-variety preferences for goods in a continuum of industries. Industries are subject to productivity and demand shocks, which are partly anticipated by firms. Firms invest to maximize expected profits. In economies with perfect levels of financial development, firms are able to obtain the desired capital given the interest rate. As a result, the equilibrium allocation of capital matches the capital allocation that equalizes expected rates of returns across industries (the target capital allocation). Financial underdevelopment potentially slows down adjustment towards the target capital allocation. Prices are endogenous and adjust immediately to equate supply and demand. The main testable implication of slow capital adjustment due to financial underdevelopment is that financially underdeveloped economies should see slow value-added growth in industries with investment opportunities due to global productivity or demand shifts (global investment opportunities).

2.1.1 Preferences, Demand, and Technology

The continuum of open economies has mass C and the continuum of industries mass I. Each industry consists of varieties differentiated by country of origin. Household preferences at time t are $U_t = \int_0^I \ln \left(\int_0^C B_{ict}^{1-\rho} x_{ict}^{\rho} dc \right)^{1/\rho} di$ with $\rho < 1$, where x_{ict} is consumption of the industry-i variety from country c in period t and B_{ict} is a preference shifter. $1/(1-\rho)$ is the elasticity of substitution among varieties. Hence, as ρ increases towards unity, national and international varieties in the same industry become better substitutes (in the limit, goods in the same industry are undifferentiated).

Households take prices as given and maximize utility subject to their budget constraint,

$\int_0^C \int_0^I p_{ict} x_{ict} didc \leq m_t$ where m_t is household expenditures and p_{ict} the price of the industry i variety from country c. The implied demand function for each variety is

$$(1) \qquad x_{ict} = B_{ict} M_{it} \left(\frac{p_{ict}}{P_{it}} \right)^{-1/(1-\rho)}$$

where $P_{it} \equiv \left(\int_0^C B_{ict} p_{ict}^{-\rho/(1-\rho)} dc \right)^{-(1-\rho)/\rho}$ is the industry-i price index and M_{it} is real world expenditures on goods in industry i. Hence, demand for the industry-i variety from country c is increasing in the preference shifter B_{ict} and expenditures on industry-i goods. Moreover, demand for each variety is decreasing in its price p_{ict} relative to prices of the international competition (summarized by P_{it}).

The production technology for varieties is

$$(2) \qquad z_{ict} = A_{ict} K_{ict}$$

where A_{ict} is total factor productivity and K_{ict} denotes capital, which does not depreciate (depreciation would not affect our result).

2.1.2 Perfect Financial Development and Target Capital

Firms take prices and the interest rate as given. Capital takes one period to become productive and firms therefore have to decide on time-t capital at $t-1$. In countries with perfect financial development, firms can obtain the desired capital at the interest rate r_{t-1}(cross-country differences in interest rates would not change our results). Firms will therefore invest until the expected marginal revenue of an additional unit of capital (the expected return to capital) is equal to the interest rate,

$$(3) \qquad E_{t-1} \left(p_{ict} A_{ict} \right) = r_{t-1}.$$

Firms face some uncertainty about both productivity and demand when making their investment decisions. In particular, we take total factor productivity and the preference shifter to be of the form

$$(4) \qquad \ln A_{ict} = \ln a_{ict} + \ln \widetilde{a}_{ict} \quad \text{and} \quad \ln B_{ict} = \ln b_{ict} + \ln \widetilde{b}_{ict}.$$

At time $t-1$, firms know the values a_{ict} and b_{ict} but only the distributions of productivity shocks $\Delta \ln \widetilde{a}_{ict} = \ln \widetilde{a}_{ict} - \ln \widetilde{a}_{ict-1}$ and demand shocks $\Delta \ln \widetilde{b}_{ict} = \ln \widetilde{b}_{ict} - \ln \widetilde{b}_{ict-1}$. We assume these shocks to be i.i.d. normally distributed and have zero mean. These assumptions imply that although time-t prices of individual varieties will be uncertain as of $t-1$, there is no uncertainty about industry price indices.

Solving the demand function in (1) for prices of individual varieties and substituting in (3) yields the profit maximizing industry capital stock in countries with perfect financial development,

$$K^*_{ict} = a_{ict}^{\rho/(1-\rho)} b_{ict} \left(E_{t-1} \widetilde{a}^{\rho}_{ict} \widetilde{b}^{1-\rho}_{ict} \right)^{1/(1-\rho)} \frac{M_{it} P_{it}^{1/(1-\rho)}}{r_{t-1}^{1-\rho}}. \tag{5}$$

The profit maximizing (target) capital stock is therefore increasing in expected demand and, when the elasticity of substitution among national and international varieties in the same industry is greater than unity ($\rho > 0$), productivity. Moreover, capital stocks are decreasing in the interest rate, and increasing in industry expenditures and prices of the international competition.

2.1.3 Adjustment to Target Capital, Financial Development, and Equilibrium Industry Growth

Consider a group of economies that start from a situation where expected rates of return are equalized across industries. We want to test the hypothesis that, following demand and productivity shifts, capital may flow only slowly from industries with low expected returns to industries with high expected returns in financially underdeveloped economies. Or, to put it differently, that the inter-industry capital allocation may adjust only slowly towards the new equilibrium target allocation (K^*_{ict}) in financially underdeveloped economies. Denoting the growth of actual and target capital between $t-1$ and t by $\Delta \ln K_{ict}$ and $\Delta \ln K^*_{ict}$ respectively, we therefore model industry capital growth as

$$\Delta \ln K_{ict} = ((1-\lambda) + \lambda \phi_c) \Delta \ln K^*_{ict} \tag{6}$$

where $\phi_c \in [0,1]$ is increasing in the level of financial development, and $\lambda \in [0,1]$ is a parameter determining the effect of financial underdevelopment on the speed of capital adjustment. If $\lambda = 0$ then $\Delta \ln K_{ic} = \Delta \ln K^*_{ic}$ whatever the level of financial development. Financial development is therefore immaterial for capital adjustment in this case. When $\lambda > 0$, however, capital adjusts more slowly in financially underdeveloped countries. As a result, some anticipated investment opportunities remain unrealized.

As there is little international industry data on capital stocks, we cannot estimate the effect of financial development on the speed of inter-industry capital reallocation using the capital allocation equation in (6). Industry value added data is, however, available for a wide cross section of countries. This makes it important to understand the implications of slow/rapid capital reallocation for industry value-added growth. Industry value-added growth is $\Delta \ln Y_{ict} = \Delta \ln(p_{ict} A_{ict} K_{ict})$ and therefore reflects capital growth; anticipated and unanticipated shifts in technology; and the response of prices to anticipated and unanticipated demand and technology shifts. While capital may adjust only slowly to demand and technology shifts, prices change quickly to equate demand and supply. Combining demand in (1), supply in (2), and the definition of target capital in (5) yields that the growth rate of industry-level returns to capital $\Delta \ln (p_{ict} A_{ict})$ can be written as

$$\Delta \ln (p_{ict} A_{ict}) = (1-\rho)(\Delta \ln K^*_{ict} - \Delta \ln K_{ict}) + \Delta \ln r_t + \eta_{ict} \tag{7}$$

where η_{ict} is a linear combination of unanticipated shifts in productivity ($\Delta \ln \widetilde{a}_{ict}$) and demand ($\Delta \ln \widetilde{b}_{ict}$) (we continue to use the notation $\Delta \ln x_t \equiv \ln x_t - \ln x_{t-1}$). The first two terms on the right-hand side of (7) capture that partial adjustment to rising (falling) target capital leads to expected returns to capital growing faster (slower) than interest rates. This wedge between expected industry returns and interest rates is smaller the more easily households substitute away from varieties with rising prices (the greater ρ).

Industry value-added growth $\Delta \ln Y_{ict} = \Delta \ln p_{ict} + \Delta \ln(A_{ict} K_{ict})$ can be obtained by combining capital growth $\Delta \ln K_{ict}$ in (6) and the growth of the marginal value product of capital $\Delta \ln(p_{ict} A_{ict})$ in (7). This yields the link between the capital reallocation hypothesis and inter-industry value-added growth we are looking for

$$\Delta \ln Y_{ict} = ((1-\theta) + \theta \phi_c) \Delta \ln K^*_{ict} + \Delta \ln r_t + \eta_{ict}, \tag{8}$$

with $\theta = \lambda \rho$; λ captures the effect of financial development on the speed of capital reallocation and ρ the effect of the elasticity of substitution between national and international varieties on the response of prices in country-industries where the growth of output is off-target due to financial underdevelopment. One important implication of (8) is that only the product of these two parameters can be identified with value-added growth data. Available estimates of the elasticity of substitution between national and international varieties, $1/(1-\rho)$, are all greater than unity (see Hummels, 2001; Feenstra, 2004; and Broda and Weinstein, 2006). Hence, we take $\rho > 0$ to be the empirically relevant case. Broda and Weinstein (2006), for example, find an average elasticity of substitution among varieties during the 1972-1998 period between 6 and 11, depending on the level of disaggregation. These estimates imply a value of ρ between 0.8 and 0.9. The values implied by the elasticity-of-substitution estimates of Hummels (2001) and Feenstra (2004) are very similar.

2.1.4 Global Investment Opportunities, Financial Development, and Industry Growth

We close the model by specifying anticipated productivity and demand shifts,

$$\Delta \ln a_{ict} = \Delta \ln a_t + \Delta \ln a_{ct} + \Delta \ln a_{it} + \varepsilon^a_{ict} \text{ and } \Delta \ln b_{ict} = \Delta \ln b_t + \Delta \ln b_{ct} + \Delta \ln b_{it} + \varepsilon^b_{ict}. \tag{9}$$

$\Delta \ln a_t$, $\Delta \ln a_{ct}$, and $\Delta \ln a_{it}$ capture the international, country, and industry component of anticipated productivity shifts. The anticipated demand shift components $\Delta \ln b_t$, $\Delta \ln b_{ct}$, and $\Delta \ln b_{it}$ are defined analogously. ε^a_{ict} and ε^b_{ict} capture anticipated country-industry productivity and demand shifts, which we take to be independent of industry specific shifts and to have a zero mean. For now we also assume independence of country-industry shifts across countries and industries; we will however relax this assumption in our empirical work.

Combining target capital in (5) and the evolution of productivity and demand in (9) yields that target capital growth, $\Delta \ln K^*_{ict}$, can be written in terms of a time, a country, and a global industry component, plus a country-industry specific residual,

$$\Delta \ln K^*_{ict} = \Delta \ln K^*_t + \Delta \ln K^*_{ct} + \Delta \ln K^*_{it} + \varepsilon_{ict}. \tag{10}$$

The residuals ε_{ict} are a linear combination of country-industry specific productivity shifts (ε^a_{ict}) and demand shifts (ε^b_{ict}). The global industry component of target capital growth, $\Delta \ln K^*_{it}$, captures global industry investment opportunities.

We can now link industry value-added growth to global investment opportunities. Substituting (10) in (8), collecting terms, and using μ_{ct} to denote global as well as country-level growth factors,

$$\Delta \ln Y_{ict} = \mu_{ct} + ((1-\theta) + \theta\phi_c)\, \Delta \ln K^*_{it} + v_{ict}, \tag{11}$$

where v_{ict} is a linear combination of anticipated (ε_{ict}) and unanticipated (η_{ict}) country-industry specific demand and productivity shifts. Hence, if financial underdevelopment slows down capital reallocation ($\lambda > 0$), value-added growth in industries with global investment opportunities will be slower in financially underdeveloped countries (recall that $\theta = \rho\lambda$ and $\rho > 0$). This is the cross-country industry growth implication of the capital reallocation hypothesis that we want to test.

2.2 Estimation Issues

The main difficulty we face in testing the cross-country industry growth implication of the capital reallocation hypothesis in (11) is that global industry investment opportunities, $\Delta \ln K^*_{it}$, are not directly observable. We start by discussing estimation when proxying global industry investment opportunities using US proxies only. Then we show how the biases of such an approach can be accounted for by adding a second proxy for global investment opportunities based on world-average industry trends.

2.2.1 Benchmarking Using Data from a Financially Developed Country

The basis of the US benchmarking approach is that actual industry investment should partly reflect global investment opportunities in a financially developed country like the US.

To explore this in more detail, suppose that US financial markets ensure that actual and target capital growth across industries coincide, $\Delta \ln K_{iUSt} = \Delta \ln K^*_{iUSt}$ (i.e. $\phi_{US} = 1$ in (6); assuming $0 < \phi_{US} < 1$ would not change any of the implications of interest here). In this case (10) implies that US industry capital growth, $\Delta \ln K_{iUSt}$, is linked to global investment opportunities, $\Delta \ln K^*_{it}$, by

$$\Delta \ln K_{iUSt} = \Delta \ln K^*_t + \Delta \ln K^*_{USt} + \Delta \ln K^*_{it} + \varepsilon_{iUSt}. \tag{12}$$

Hence, US capital growth partly reflects global investment opportunities.

The existing literature uses industry value-added growth or sales growth as a proxy for the opportunities that should trigger capital reallocation in financially developed countries (Wurgler, 2000; Fisman and Love, 2004a). It is therefore interesting to see whether we could use value-added growth instead of capital growth as a proxy for global investment opportunities (value added and sales coincide in our model). Because value-added growth is partly driven by capital growth, global investment opportunities will be reflected in industry value-added growth in financially developed countries. Value-added growth is, however, a noisier proxy for investment opportunities than capital growth, because value-added growth also reflects unanticipated demand and productivity shocks (this can be seen by, for example, substituting (12) into (8), which yields $\Delta \ln Y_{iUS} = \Delta \ln K^*_{iUS} + \Delta \ln r + \eta_{iUS}$ where η_{iUS} is a linear combination of unanticipated US-specific demand and productivity shifts).

Combining (11) and (12), collecting terms, and denoting industry-level growth factors by μ_{it} yields

$$\Delta \ln Y_{ict} = \mu_{ct} + \mu_{it} + \theta \phi_c \Delta \ln K_{iUSt} + u_{ict}, \tag{13}$$

where u_{ict} is a linear combination of anticipated and unanticipated country-industry specific demand and productivity shifts (v_{ict}) and US-specific anticipated industry demand and productivity shifts (ε_{iUSt}).

The key question is whether (13) can be used for testing the cross-country industry growth implication of the capital reallocation hypothesis ($\theta > 0$) using cross-country (non-US) value-added growth data.[1] As we show next, least-squares estimation of (13) may lead us to understate the role of financial development for growth or find an effect although financial development is irrelevant for inter-industry capital reallocation.

[1]US industry value-added growth cannot be used to estimate (13) because US industry capital growth and value-added growth both reflect anticipated US-specific industry demand and productivity shifts.

Downward Bias Due to Classical Measurement Error Suppose anticipated US specific industry investment opportunities (ε_{iUSt} in (12)) are independent of all other determinants of industry growth. In this case, the gap between US industry capital growth and global industry investment opportunities, $\Delta \ln K_{iUSt} - \Delta \ln K_{it}^*$, is independent of all other model variables. Hence, (11) and (12) constitute a classical errors-in-variables model, and a least-squares approach to (13)—the reduced form of (11) and (12)—yields downward biased estimates of the effect of financial development on the speed of reallocation (θ). The asymptotic size of the attenuation bias is greater the more important the idiosyncratic element in US industry investment. To see this, it is easiest to think of the cross-industry speed-of-reallocation parameter $\sigma = (1-\theta) + \theta\phi$ in (11) being estimated country by country, using US industry capital growth $\Delta \ln K_{iUSt}$ as a proxy for global industry investment opportunities $\Delta \ln K_{it}^*$ and allowing for different (country) intercepts in each regression. This yields an estimate of σ in a country with financial development ϕ equal to $\sigma^{LS} = ((1-\theta) + \theta\phi)\,[VAR(\Delta \ln K_{it}^*)/VAR(\Delta \ln K_{iUSt}^* | \Delta \ln K_t^*, \Delta \ln K_{USt}^*)]$, where the (attenuation) term in brackets is the so-called reliability ratio (e.g. Greene, 2000). $VAR(\Delta \ln K_{iUSt}^* | \Delta \ln K_t^*, \Delta \ln K_{USt}^*)$ is the variance of US industry investment conditional on the global component ($\Delta \ln K_t^*$) and the country-level component ($\Delta \ln K_{USt}^*$), which are both captured by country intercepts. The effect of financial development on the cross-industry speed of reallocation, $\partial \sigma^{LS} / \partial \phi$, is therefore

$$(14) \quad \theta^{LS} = \theta \frac{VAR(\Delta \ln K_{it}^*)}{VAR(\Delta \ln K_{iUSt}^* | \Delta \ln K_t^*, \Delta \ln K_{USt}^*)} = \theta \frac{VAR(\Delta \ln K_{it}^*)}{VAR(\Delta \ln K_{it}^*) + VAR(\Delta \ln \varepsilon_{iUSt})},$$

where the second equality makes use of (12). A larger idiosyncratic element in US industry investment (a larger variance of ε_{iUSt}) therefore implies a stronger attenuation bias.

Upward Bias Due to Non-Classical Measurement Error But what if more financially developed countries face investment opportunities that are better proxied by US opportunities? To see that using only US proxies for industry investment opportunities may lead to spurious evidence in favor of the capital reallocation hypothesis, consider an extreme example where countries have either high or low levels of financial development. Suppose that investment opportunities in all financially developed countries (this group includes the US) have the same country-industry component; that is, $\varepsilon_{ic} = \varepsilon_{iUS}$ for all economies c that are financially developed. Country-industry components of investment opportunities faced by financially underdeveloped countries, on the other hand, are completely unrelated to those of financially developed countries; $E(\varepsilon_{ic}\varepsilon_{iUS}) = 0$ for all economies c that are financially underdeveloped. In this case, US industry capital growth is a noisy measure of industry investment opportunities in financially underdeveloped countries. Hence, using only US proxies for opportunities when estimating the cross-industry speed of reallocation in financially underdeveloped countries will result in downward biased results. What about taking the same approach to obtain the cross-industry speed of reallocation in financially developed countries (other than the US)? Clearly, these estimates will be unbiased because US industry investment is a perfect measure of industry investment opportunities in other financially developed countries (the country-level component of investment opportunities will be captured by country intercepts). Underestimating the speed-of-reallocation parameter for financially underdeveloped countries only, amounts to overstating the effect of financial development on the cross-industry speed of reallocation. As a result, researchers using only US proxies for global industry investment opportunities may conclude that there is empirical support for the capital reallocation hypothesis although the speed of inter-industry capital reallocation is the same in all countries.

Measurement Error Bias in the General Case In general, US data is likely to yield a noisy measure of investment opportunities in all other countries, including those that are financially developed. As a result, there are two countervailing biases when using only US proxies for global investment opportunities. Attenuation bias due to classical measurement error, and an upward bias due to US data yielding a noisier proxy for industry opportunities in financially underdeveloped countries. Which of the two biases dominates depends on the exact properties of the measurement error.

2.2.2 Accounting for Measurement Error

Measurement error bias when using only US proxies for global investment opportunities arises because US industry investment responds to both global and US specific opportunities. The bias could be avoided by combining US proxies for global investment opportunities with a second indicator of industry opportunities that is correlated with the global component of US industry capital growth but does not reflect the US (financial-development) specific component—or the specifics of another country. This second indicator could be used as an instrument for US capital growth in (13) to obtain a consistent test of the cross-country industry growth implication of the capital reallocation hypothesis.

One such indicator of global opportunities would appear to be average cross-country (world-average) value-added growth by industry. But this indicator may actually not reflect world-average industry opportunities well, because industry growth in many countries might not respond to opportunities due to financial underdevelopment or other country-level factors. A better indicator is therefore world-average growth by industry controlling for the effects of financial underdevelopment or other country-level growth determinants. We estimate this proxy in two steps. First, we regress country-industry value-added growth on industry effects and country-level growth determinants to obtain a least-squares prediction for industry-i growth in country c as

$$\widehat{\Delta \ln Y_{ic}} = \widehat{\gamma}_c + \widehat{\gamma}_i + \widehat{\delta}_i \phi_c, \tag{15}$$

where $\widehat{\gamma}_c$ is the estimated country effect; $\widehat{\gamma}_i$ the estimated industry growth if the industry were located in a country with the lowest level of financial development ($\phi_c = 0$); and $\widehat{\delta}_i$ the estimated marginal effect of financial development on growth in industry i. Second, we estimate industry growth rates $\Delta \widehat{\ln Y^G_{iFD}}$ in a financially developed (FD) country with the world-average (G) industry opportunities as

$$\Delta \widehat{\ln Y^G_{iFD}} = \widehat{\gamma}_i + \widehat{\delta}_i \phi_{US}, \tag{16}$$

where we have taken "financially developed" to correspond to a level of financial development equal to the US value (ϕ_{US}). The estimates in (16) only reflect world-average industry opportunities (more precisely, non-US world-average opportunities as we will drop the US when estimating (15)). Or, to put it differently, estimated growth rates in (16) do not reflect opportunities that are specific to a country or level of financial development.[2] We can therefore test the cross-country industry growth implications of the capital reallocation hypothesis by using the global opportunities indicator in (16) as an instrument for US industry capital growth in (13).

3 Data

Industry value added data come from the Industrial Statistics of the United Nations Industrial Development Organization (INDSTAT3 Revision 2 database). The database reports US dollar values for 28 3-digit International Standard Industrial Classification (ISIC) manufacturing industries.[3] We deflate the data using the US producer price deflator and then obtain value-added growth $\Delta \ln Y_{ic}$ ($GROWTH_{ic}$) as the annual log change of value added

[2] The model implies $\gamma_i = (1-\theta)\Delta \ln K^*_i$ and $\delta_i = \theta \Delta \ln K^*_i$, see (11). Hence, $\Delta \widehat{\ln Y^G_{iFD}}$ in (16) is an estimate of industry growth in a financially developed country subject to only global demand and technology shifts.

[3] The early cross-country industry growth literature uses 3-digit data plus selected 4-digit industries, see Rajan and Zingales (1998). The recent literature works at the 3-digit level where data is available for more countries (e.g. Klingebiel, Kroszner, and Laeven, forthcoming; Dell'Arricia, Detraghiace, and Rajan, 2005).

from 1980 to 1989. Such data is available for 72 countries. We drop countries with value added data in less than 10 industries. We also drop Taiwan because there is no data on financial development in the 1980s and the US because it is the country used for industry benchmarking. This leaves us with the 67 countries listed in the Data Appendix. (The Data Appendix also contains the definitions and sources of all the variables used in the empirical analysis.)

The US industry data come from the NBER Manufacturing Productivity Database (Bartelsman and Gray, 1996). We use this database to obtain industry-level capital growth $\Delta \ln K_{iUS}$ ($CAPGR_i$) calculated as the annual log change of the real capital stock from 1980 to 1989; sales growth ($SALESGR_i$) calculated as the annual log change of sales from 1980 to 1989;[4] and value-added growth ($VAGR_i$) calculated as the annual log change of value added from 1980 to 1989. Table I reports these industry growth rates plus the external finance dependence ($EXTFIN_i$) of US industries for all 28 manufacturing industries. External finance dependence is obtained as one minus industry cash-flow over industry investment averaged over the 1980-1989 period obtained using COMPUSTAT data (from Klingebiel, Kroszner, and Laeven, forthcoming). This measure of external-finance dependence was first proposed by Rajan and Zingales (1998).

The level of financial development of countries (FD_c) is measured as total credit provided to the private sector relative to GDP averaged between 1980 and 1989, from the 2005 World Bank World Development Indicators. The other country variables used in our empirical analysis are listed in the Data Appendix and also come from standard sources. The values of all country variables, as well as summary statistics for the industry and country data are reported in our Supplementary Appendix.[5] The Supplementary Appendix also contains additional robustness checks.

4 Results

4.1 Main Results

We first present results on the role of financial development for growth in industries with investment opportunities using only US proxies for global opportunities. Then we take into account that this approach introduces measurement error because US industries respond to global as well as US (financial development) specific investment opportunities. We conclude by examining alternative measures of industry opportunities.

[4] Fisman and Love (2004a) obtain sales growth from COMPUSTAT, which covers public firms only.
[5] Available at http://www.econ.upf.edu/crei/people/ciccone/papers.htm.

4.1.1 Using US Proxies for Global Industry Opportunities Only

Our baseline estimating equation is (13), which for convenience we rewrite as

$$GROWTH_{ic} = f_c + f_i + \alpha\left(FD_c * CAPGR_i\right) + u_{ic}, \tag{17}$$

where $GROWTH_{ic}$ is country-industry value-added growth and $FD_c * CAPGR_i$ is the interaction between country-level private credit and industry-level investment opportunities. f_i and f_c are vectors of industry and country effects that control for global inter-industry growth differences and country-level growth determinants respectively. And u_{ic} captures unobserved factors affecting country-industry growth. The hypothesis that we are interested in testing is that financially developed countries experience faster growth in industries with investment opportunities ($\alpha > 0$).

In Table II, column (1), we estimate (17) using ordinary least-squares. The coefficient on country-level financial development interacted with industry-level investment opportunities ($FD_c * CAPGR_i$) is positive and significant at the 1% level. Hence, industries with better investment opportunities grow faster in financially developed countries. The coefficient estimate implies an annual growth differential of approximately one percent between the industry at the $75th$ percentile and the industry the $25th$ percentile of investment opportunities (Plastic Products versus Industrial Chemicals) when they operate in a country with private credit at the $75th$ percentile rather than a country close to the $25th$ percentile (Chile versus Ecuador). This effect is large relative to the mean and the median industry value-added growth rates in our sample (1.5% and 1.3% respectively).

In column (2), we examine how results change when (17) is estimated using a robust regression approach that assigns lower weights to influential observations (Huber, 1964, 1981). This check is important because the UNIDO industry data are noisy and ordinary least-squares estimates can be sensitive to the values of a few observations (Temple, 1998).[6] The robust regression coefficient on the $FD_c * CAPGR_i$ interaction is similar to that in column (1) and remains statistically significant at the 1% level.

In column (3) and (4), we examine whether the interaction between financial development and investment opportunities is robust to controlling for the effect of financial development on growth in external-finance-dependent industries. Following Rajan and Zingales (1998), we include an interaction between financial development and industry external-finance dependence ($FD_c * EXTFIN_i$) among the right-hand-side variables in (17). We also include the initial share of the industry in total country-level manufacturing value added ($SHARE_{ic}$) that Rajan and Zingales use to control for differences in initial conditions. The results show

[6] Many country-industry studies therefore cut off observations in the tails of the distribution.

that the interaction between private credit and investment opportunities continues to enter positively and highly significantly, whether we use an ordinary least-squares approach in column (3) or robust regression approach in column (4). Our Supplementary Appendix shows that the interaction between financial development and industry investment opportunities is robust to using other financial development indicators and to controlling for additional industry growth factors suggested in the literature (e.g. Claessens and Laeven, 2003; Braun, 2003; Ciccone and Papaioannou, 2005).

4.1.2 Accounting for Measurement Error in US Proxies

US industry investment opportunities are a noisy measure of global opportunities. It is therefore important to check on tests of the industry growth implications of the capital reallocation hypothesis based only on US proxies for global opportunities. We have shown earlier that this can be done using a second proxy for global investment opportunities that does not reflect opportunities specific to a country or level of financial development. Our second proxy is average cross-country value-added growth by industry controlling for growth not reflecting opportunities in financially underdeveloped countries, $\Delta \widehat{\ln Y^G_{iFD}}$ in (16). We will work with two sets of estimates. One set ($GLOPP_i$) is obtained by estimating the parameters in (15) using ordinary least squares. For robustness, we also obtain another set ($RGLOPP_i$) using the robust regression approach already employed earlier. In both instances, (15) is estimated excluding the US from the sample.

The positive correlation of US industry capital growth ($CAPGR_i$) with our two indicators of world-average non-US industry opportunities is evident from Figures Ia and Ib. Figure Ia plots $CAPGR_i$ on the vertical axis against $GLOPP_i$ on the horizontal axis. The scatter cloud shows that industries with better non-US world average opportunities saw more rapid capital growth in the US. Table III, Panel B, column (1) contains the results of regressing $CAPGR_i$ on $GLOPP_i$. The slope estimate is 0.48 and highly statistically significant (the t-statistic is 3.54). Hence, a 1% difference in world-average non-US growth opportunities between two industries leads, on average, to a 0.48% difference in US capital growth between the same industries. Figure Ib confirms that US industry capital growth is faster in industries with better global opportunities by plotting $CAPGR_i$ on the vertical axis against our robust world-average non-US opportunities measure ($RGLOPP_i$) on the horizontal axis. The scatter cloud brings out the positive correlation clearly. Table III, Panel B, column (2) contains the corresponding regression results. Regressing $CAPGR_i$ on $RGLOPP_i$ yields a highly significant slope estimate of 0.67 (the t-statistic is 4.71). Hence, again, the evidence suggests that US industry investment is higher in industries with better world-average non-US opportunities, as one would expect if US investment partly responded to global opportunities.

Table III, Panel A reports the instrumental-variables results on the role of financial development for growth in industries with investment opportunities. The estimate in column (1) instruments the interaction between financial development and US industry opportunities ($FD_c * CAPGR_i$) by $FD_c * GLOPP_i$. The coefficient on the $FD_c * CAPGR_i$ interaction is now 1.06 with a t-statistic of 3.86. Hence, the instrumental-variables approach yields a highly significant effect of financial development on growth in industries with global opportunities. This result is confirmed in column (2), where the $FD_c*CAPGR_i$ interaction is instrumented by $FD_c*RGLOPP_i$ to check for the role of influential observations in obtaining world-average non-US opportunities. This approach yields the coefficient on the interaction of 0.63 with a t-statistic of 3.49.[7]

Hence, the instrumental-variables approach in Table III yields a larger effect of financial development on growth in industries with global opportunities than the approach based on a US proxy only (in Table II).[8] This indicates that estimates based only on the US opportunities proxy are dominated by classical measurement error bias due to US industry investment responding to US idiosyncrasies. This is also evident from Figures Ia and Ib, which show much dispersion of US capital growth around the regression line. The dispersion is also evident from the R^2 of the corresponding regression results, see Table III, Panel B.

It is possible to get a sense of the magnitude that the idiosyncratic component of US capital growth must have to explain the differences between the results in Table III and Table II. The formula in (14) states that, asymptotically, estimates of θ based on US proxies for global opportunities will be equal to the true coefficient times the reliability ratio $VAR(\Delta \ln K_i)/VAR(\Delta \ln K_{iUS})$. The reliability ratio is simply the part of the cross-industry US capital growth variance driven by global opportunities. Hence, if 25% to 50% of US industry capital growth is a response to global, rather than US specific, opportunities, the true value of θ will be two to four times the estimate based on US proxies only. Hence, the difference between the (consistent) instrumental-variables estimate of θ in Table III an the estimates based only on US proxies in Table II would be consistent with a global component in US industry investment of between 25 and 50%. (These calculations are only indicative; they hold exactly only asymptotically when all measurement error takes the classical form.)

[7] The first-stage coefficients and t-statistics, based on standard errors clustered by country, of the $GLOPP_i$ and $RGLOPP_i$ interactions are exactly the same as the coefficients and t-statistics reported in Table III, Panel B, columns (1) and (2) respectively.

[8] A Hausman test yields that the difference between the OLS and IV estimate is statistically significant at the 0.1% level.

4.1.3 Alternative Proxies for Industry Opportunities

So far we have proxied US industry opportunities by the growth of industry capital, as investment in a financially developed country like the US should closely reflect profit opportunities anticipated by firms and financial markets. Two alternative proxies for opportunities are industry sales growth (e.g. Fisman and Love, 2004a) and industry value-added growth (e.g. Wurgler, 2000).[9] Like investment, sales and value-added growth reflect expected profit opportunities; but unlike investment, they may also end up reflecting unanticipated demand and productivity shocks. As a result, sales or value-added growth may be a nosier measure of anticipated industry opportunities than capital growth. This should manifest itself empirically in two ways. First, US industry capital growth rather than sales or value-added growth should predict cross-country industry growth when both are taken in account. Second, the effect of financial development on growth in industries with opportunities should become stronger when we focus on the anticipated global component of US industry sales or value-added growth (using our two-stage least squares approach). These implications are examined in Table IV.

In Table IV, column (1) we include financial development interacted with both the capital-growth opportunities measure ($FD_c * CAPGR_i$) and with the sales-growth opportunities measure ($FD_c * SALESGR_i$) in the regression. It turns out that only the interaction with industry capital growth is statistically significant (at the 1% level), which is consistent with industry sales growth measuring anticipated opportunities with greater noise than capital growth.

In column (2) and (3), we focus on the sales-growth opportunities measure only. Column (2) contains the least-squares effect of the $FD_c * SALESGR_i$ interaction. Column (3) estimates the same specification using the two-stage least-squares approach already employed earlier (with $FD_c * GLOPP_i$ as an instrument for $FD_c * SALESGR_i$). If industry sales growth is a noisier measure of global investment opportunities than capital growth, the two-stage least-squares estimate should be larger than the least-squares estimate—as in the case of the capital-growth opportunities proxy. In fact, the two-stage least-squares estimate in column (3) is more than six times the least-squares estimate in column (2).[10] It is also interesting to note that the two-stage least-squares estimate using the sales-growth proxy (1.056) is basically identical to the two-stage least-squares estimate using the capital-growth proxy (1.061; in column (1) of Table II).

[9] Sales growth is the proxy most often used in the finance literature because data on sales is often readily available, see for example La Porta, Lopez-de-Silanes, Shleifer, and Vishny (2002).

[10] A Hausman test yields that the difference between the OLS and IV estimate is statistically significant at the 0.1% level.

Columns (4) to (6) repeat the analysis of the previous columns using value-added growth instead of sales growth as a proxy for industry opportunities. The pattern of results is similar. The capital-growth proxy dominates when the two opportunities proxies are combined (in column (3)). And the two-stage least-squares estimate using the value-added-growth proxy (in column (5)) exceeds the least-squares effect (in column (4)).

4.2 Further Evidence

Is it specifically financial development that leads to faster growth in industries with opportunities? Or could it be the broader set of factors associated with economic development? We also address whether our findings prevail when we also instrument for financial development.

4.2.1 Alternative Capital Reallocation Hypotheses

Economic versus Financial Development Financial development is only one aspect of economic development. Maybe capital reallocation to industries with investment opportunities is driven by the broad set of factors leading of economic development, rather than financial development in particular? This is the question examined in Table V.

In column (1) and (2), we address the question of economic versus financial development as drivers of growth in industries with investment opportunities by adding an interaction between industry investment opportunities and income per capita ($Y_c * CAPGR_i$) to the specification in (17). This allows us to test whether financial development matters conditional on economic development. The results show this to be the case. The interaction between financial development and industry investment opportunities ($FD_c * CAPGR_i$) continues to be positive and highly significant in column (1) where we use an ordinary least-squares approach. This continues to be the case in column (2) where we instrument $FD_c * CAPGR_i$ and $Y_c * CAPGR_i$ by $FD_c * GLOPP_i$ and $Y_c * GLOPP_i$ respectively. The economic development interaction also enters positively, although the coefficient only becomes statistically significant when we use our two-stage least-squares approach. In columns (3) and (4), we check the robustness of the link between financial development and growth in industries with opportunities by dropping low income countries from the sample (as classified by the World Bank).[11] The financial development interaction with investment opportunities remains positive and highly significant using the least-squares approach (in column (3)) or the instrumental-variables approach (in column (4)). Again, there is no evidence that financial development matters only because it stands in for economic development.

[11] The low income countries in our sample are Burundi, Ivory Cost, Indonesia, Bangladesh, Kenya, Central African Republic, Malawi, Pakistan, Cameroon, India, Senegal, Zimbabwe, and Papua New Guinea.

Legal Quality, Property Rights, and Human Capital In Table VI, columns (1) to (8), we examine whether growth in industries with investment opportunities is driven by legal system effectiveness and property rights protection, two aspects of the quality of a country's institutions, rather than financial development.

Columns (1) to (4) analyze the role of legal system ineffectiveness. The indicator used ($LAWINEF_c$) is the time it takes to resolve a payment dispute in court. In column (1), it can be seen that the interaction between legal system ineffectiveness and investment opportunities ($LAWINEF_c * CAPGR_i$) enters negatively and significantly when we do not control for the financial development interaction. Hence, countries with ineffective legal systems experience slower growth in industries with opportunities. In column (2), we include both the legal ineffectiveness interaction and the financial development interaction with investment opportunities. The financial development interaction enters positively and significantly, while the legal ineffectiveness interaction is now insignificant. Therefore, financial development matters for growth in industries with investment opportunities even when we take into account for differences in legal system effectiveness. Legal system effectiveness also matters for taking advantage of growth opportunities, but only through its effects on financial development. Columns (3) and (4) yield the same pattern of results when we instrument the investment opportunities interactions with financial development and legal system ineffectiveness by interactions between value-added growth at the US level of financial development predicted using data on all countries except the US ($GLOPP_i$) and the respective country level variable.

In columns (5) to (8) we turn to the role of property rights protection. Column (5) shows that countries with higher values of the property rights protection index ($PROP_c$) see faster growth in industries with investment opportunities. In column (6), we add the financial development interaction to the specification. This interaction enters again positively and significantly, while the property rights interaction with industry opportunities is insignificant. Hence, the effect of financial development on growth in industries with investment opportunities is robust to controlling for property rights protection. Property rights protection, on the other hand, matters through financial development. This pattern of results prevails in columns (7) and (8) where we instrument the investment opportunities interactions with financial development and property rights protection by interactions between value-added growth at the US level of financial development predicted using data on all countries except the US and the respective country level variable.

Taking advantage of industry growth opportunities may also be easier in countries with a well-educated labor force. Columns (9) to (12) look at this issue using average years of schooling in 1980 (SCH_c) across countries. In column (9) we find that countries with higher levels of schooling see faster growth in industries with investment opportunities. But this effect becomes insignificant when we control for the role of financial development in column (10). Financial development, on the other hand, remains a positive and highly significant determinant of growth in industries with investment opportunities. This pattern of results is repeated when we use our two-stage least-squares approach in columns (11) and (12).

4.2.2 Instrumenting Financial Development

One advantage of examining the finance-growth nexus through the role of financial development for relative industry performance is that feedback from financial development to growth is less of a concern than in cross-country growth analysis (Rajan and Zingales, 1998). It is still useful, however, to see how our empirical results change when we follow the cross-country literature and use the La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998, 1999) measures of legal origin as instruments for financial development (Levine, 2005, reviews the cross-country work taking this approach). These dummies assign each country to one of five legal families (English; French; German; Nordic; and Socialist). Since the legal system of countries is historically predetermined, it is unlikely to be affected by feedback industry-level demand and supply shifts in the 1980s or the preceding decades.

In Table VII, column (1) we report two-stage least-squares estimates when instrumenting the financial development interaction with investment opportunities ($FD_c * CAPGR_i$) using interactions between legal origin dummies and estimated world-average non-US industry opportunities ($Legal\ Origin_c * GLOPP_i$). Column (2) re-estimates the specification using world-average non-US industry opportunities estimated with a robust regression approach (i.e. the instrument is now $Legal\ Origin_c * RGLOPP_i$). The point estimates of the effect of the $FD_c * CAPGR_i$ interaction on country-industry value-added growth is 0.81 and 0.72 respectively, and highly statistically significant in both cases.[12] These estimates imply an annual value-added growth differential between the industry at the 75th and the industry at the 25th percentile of investment opportunities of around 2% in a country at the 75th percentile of private credit compared to the country at the 25th percentile.

5 Conclusions

Financial development could be contributing to country-level productivity growth because it results in capital being reallocated more rapidly to high-productivity industries. To test

[12] A Hausman test yields that the difference between the OLS and IV estimate is statistically significant at the 0.1% level.

this capital reallocation hypothesis, we embed it in a multi-industry world equilibrium model where industries are subject to country-specific as well as global demand and productivity shifts. These shifts are partly anticipated by firms and financial markets and therefore give rise to country-specific as well as global investment opportunities. A testable implication of the capital reallocation hypothesis turns out to be that financially developed countries see faster value-added growth in industries with global investment opportunities.

Testing this industry growth implication of the capital reallocation hypothesis requires a proxy for (latent) global industry investment opportunities. If investment opportunities are partly global and actual investment responds to opportunities in financially developed countries, then global industry investment opportunities will be reflected in investment levels of financially developed countries. US industry capital growth is therefore one of our proxies for global industry investment opportunities.

Using only US proxies for global investment opportunities will introduce measurement error in the empirical analysis. If such error entirely reflects US idiosyncrasies, it will lead us to understate the role of financial development for capital reallocation. But if measurement error also reflects demand and productivity shifts that are specific to financially developed countries, then we may end up understating or overstating the effect of financial development on industries with investment opportunities.

This makes it important to check on tests of the industry growth implications of the capital reallocation hypothesis based only on US proxies for global opportunities. We propose an approach that combines the US proxy for global industry investment opportunities with another proxy that does not reflect opportunities specific to a country or level of financial development. This other proxy is world-average opportunities, which we estimate as average cross-country growth by industry—excluding the US from the sample—taking into account that growth may not reflect opportunities in financially underdeveloped countries. Our estimates turn out to have a strong positive effect on US industry capital growth, as one would expect if US investment partly reflected global opportunities.

Hence, we can test the cross-country industry growth implication of the capital reallocation hypothesis using a two-stage least-squares approach to focus on global opportunities. The first-stage relates US industry capital growth to estimated world-average industry opportunities (excluding the US). The second-stage uses global industry investment opportunities (predicted industry capital growth from the first stage) to estimate the effect of financial development on growth in industries with global investment opportunities. This approach yields clear support for the industry growth implications of the capital reallocation hypothesis.

A Data Appendix

A.1 Country Sample

Australia (AUS), Austria (AUT), Burundi (BDI), Belgium (BEL), Bangladesh (BGD), Bolivia (BOL), Barbados (BRB), Central African Republic (CAF), Canada (CAN), Chile (CHL), China (CHN), Côte d'Ivoire (CIV), Cameroon (CMR), Colombia (COL), Costa Rica (CRI), Cyprus (CYP), Germany (DEU), Denmark (DNK), Ecuador (ECU), Egypt, Arab Rep.(EGY), Spain (ESP), Finland (FIN), Fiji (FJI), France (FRA), United Kingdom (GBR), Greece (GRC), Hungary (HUN), Indonesia (IDN), India (IND), Ireland (IRL), Iran, Islamic Rep. (IRN), Iceland (ISL), Israel (ISR), Italy (ITA), Jamaica (JAM), Jordan (JOR), Japan (JPN), Kenya (KEN), Korea, Rep. (KOR), Kuwait (KWT), Sri Lanka (LKA), Luxembourg (LUX), Morocco (MAR), Malta (MLT), Mexico (MEX), Mauritius (MUS), Malawi (MWI), Malaysia (MYS), Netherlands (NLD), Norway (NOR), New Zealand (NZL), Pakistan (PAK), Panama (PAN), Philippines (PHL), Papua New Guinea (PNG), Poland (POL), Portugal (PRT), Senegal (SEN), Singapore (SGP), Sweden (SWE), Swaziland (SWZ), Trinidad and Tobago (TTO), Turkey (TUR), Uruguay (URY), Venezuela, RB (VEN), South Africa (ZAF), Zimbabwe (ZWE)

A.2 Variable Definitions and Sources

Country-Industry Specific

- $GROWTH_{ic}$: Annual change of log value added in industry i in country c over the 1980-1989 period. The variable is originally expressed in US dollars. We deflate the data using the US manufacturing PPI (from the Federal Reserve Bank of St. Louis Economic Databases) to facilitate comparisons. Source: United Nations Industrial Development Organization (UNIDO) Industrial Statistics, 2005.

- $SHARE_{ic}$: Share of industry i in total value added in manufacturing in country c in 1980. No data is available fro Mexico. Source: UNIDO Industrial Statistics.

Industry-Specific

- $EXTFIN_i$: Industry dependence on external financing. Defined as the industry-level median of the ratio of capital expenditure minus cash flow to capital expenditure for U.S. firms averaged over the 1980-1989 period. Source: Klingebiel, Krozner, Laeven (forthcoming); constructed similarly to Rajan and Zingales (1998) at the 3-digit ISIC. Original source: COMPUSTAT.

- $CAPGR_i$: Annual change of log real capital stock in industry i in the US over the 1980-1989 period. Source: NBER-CES Manufacturing Industry Database (Bartelsman and Gray, 1996).

- $VAGR_i$: Annual change of log value added in industry i in the US averaged over the 1980-1989 period. Source: NBER-CES Manufacturing Industry Database (Bartelsman and Gray, 1996).

- $SALESGR_i$: Annual change of log shipments in industry i in the US averaged over the 1980-1989 period. Source: NBER-CES Manufacturing Industry Database (Bartelsman and Gray, 1996).

- $GLOPP_i$ ($RGLOPP_i$): Estimated industry value-added growth at the U.S. level of financial development (estimated world-average industry opportunities). These estimates are obtained in two steps.

  - Step 1: Regress $GROWTH_{ic}$ on country dummies, industry dummies, and industry dummies interacted with country-level financial development (as a control for industry-specific effects of financial underdevelopment). See Equation (15) in the main text.

  - Step 2: Obtain $GLOPP_i$ as predicted $GROWTH_{ic}$ for a country c with a level of financial development equal to the U.S. See Equation (16) in the main text.

  $RGLOPP_i$ differs from $GLOPP_i$ only in that the first step is based on a robust-regression approach (an iterative least-squares method that assigns lower weight to influential observations).

Country-Specific:

- FD_c : Domestic credit to the private sector relative to GDP. Domestic credit refers to financial resources provided through loans, purchases of non-equity securities, trade credits, and other accounts receivable that establish a claim for repayment. We use the natural logarithm of the average of the variable over the period 1980-1989. Source: World Bank World Development Indicators Database (2005).[Series: FS.AST.PRVT.GD.ZS]

- Y_c : Real per capita GDP. We use the natural logarithm of the variable in 1980. Source: Penn World Tables 5.6.

- $PROP_c$: Index of property rights protection on a scale from 1 to 5; higher values indicate higher protection. The index refers to the median in the 1995-1999 period. Source: The Index of Economic Freedom (The Heritage Foundation), 2005 edition.

- SCH_c : Average years of schooling of the population aged 25 and over in 1980. Source: Barro and Lee (2001).

- $LAWINEF_c$: Index of the ineffectiveness of the legal system, based on the number of days to resolve a payment dispute through courts (calendar days to enforce a contract of unpaid debt worth 50% of the country's GDP per capita). Source: Djankov, McLiesh and Shleifer (forthcoming).

- $Legal\ Origin_c$: A set of dummy variable that identifies the legal origin of the Company law or Commercial Code of each country. There are five legal families: English (Common Law), French (Civil Law), German (Civil Law), Nordic (Civil Law), and Socialist. Source: La Porta, *et al.* (1999).

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Figure I.a

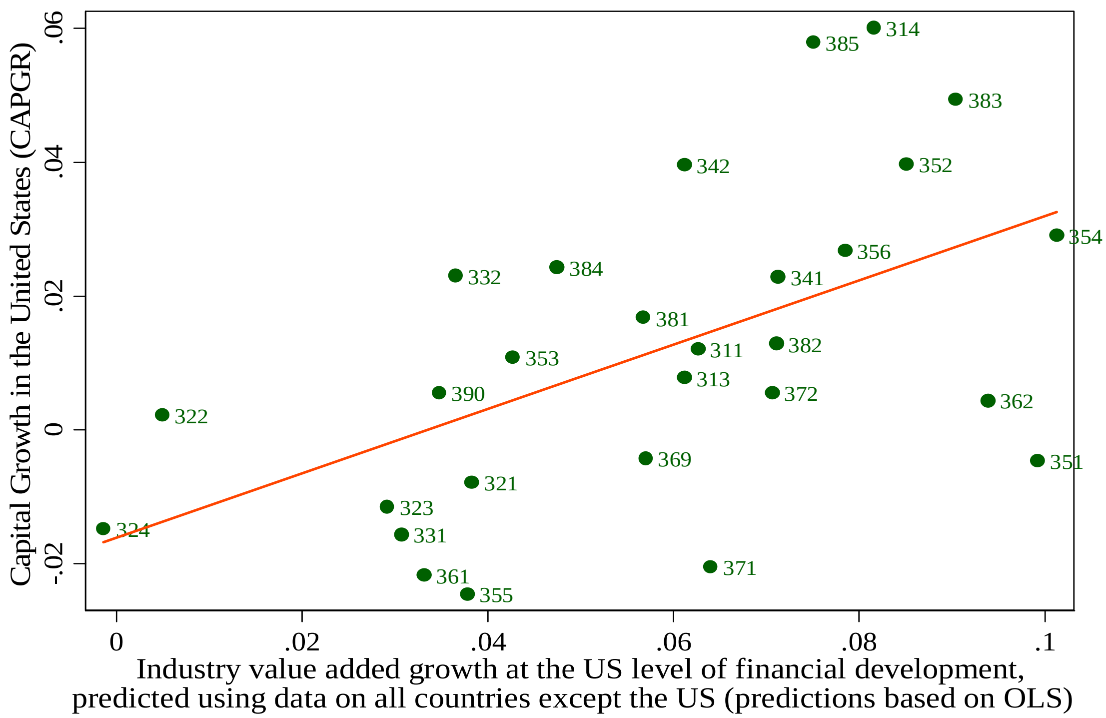
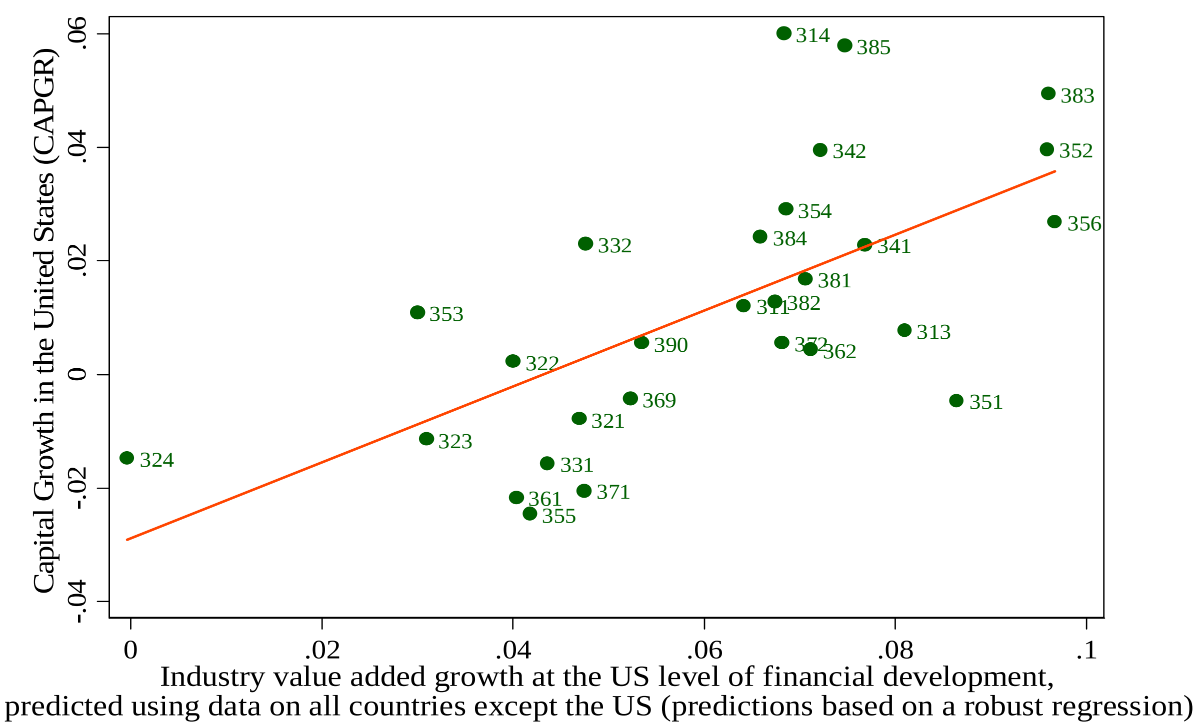


Figure I.b



The Figures plot US industry-level capital growth (CAPGR; on the vertical axis) against predicted value added growth at the US level of financial development using data on all countries except the US. In Figure I.a predictions (GLOPP) are based on estimating equation (15) in the main text using OLS. In Figure I.b predictions (RGLOPP) are based on estimating equation (15) with a robust regression approach that assigns lower weights to influential observations. For more information on these predictions see Sections 2.2.2 and 4.1.2 in the main text. (The industries corresponding to the codes in the figures can be found in Table I.)

Table I: Industry-Level Variables

ISIC	Industry Name	Capital Growth *(CAPGR)*	Sales Growth *(SALESGR)*	VA Growth *(VAGR)*	External Finance *(EXTFIN)*
314	Tobacco	0.0601	0.0890	0.1265	-0.45
385	Professional & scientific equipment	0.0579	0.0814	0.0816	0.96
383	Machinery, electric	0.0494	0.0653	0.0618	0.95
352	Other chemicals	0.0397	0.0823	0.0893	0.75
342	Printing and publishing	0.0396	0.0872	0.0894	0.20
354	Petroleum and coal products	0.0291	0.0433	0.0491	0.33
356	Plastic products	0.0268	0.0795	0.0745	1.14
384	Transport equipment	0.0243	0.0596	0.0641	0.36
332	Furniture, except metal	0.0231	0.0670	0.0662	0.24
341	Paper and products	0.0229	0.0705	0.0819	0.17
381	Fabricated metal products	0.0168	0.0356	0.0344	0.24
382	Machinery, except electrical	0.0129	0.0169	0.0133	0.60
311	Food products	0.0121	0.0419	0.0646	0.14
353	Petroleum refineries	0.0109	0.0005	-0.0021	0.04
313	Beverages	0.0078	0.0536	0.0681	0.08
372	Non-ferrous metals	0.0056	0.0308	0.0277	0.01
390	Other manufactured products	0.0055	0.0443	0.0495	0.47
362	Glass and products	0.0044	0.0452	0.0441	0.53
322	Wearing apparel, except footwear	0.0023	0.0388	0.0404	0.03
369	Other non-metallic mineral products	-0.0042	0.0362	0.0414	0.06
351	Industrial chemicals	-0.0046	0.0448	0.0529	0.25
321	Textiles	-0.0078	0.0402	0.0412	0.19
323	Leather products	-0.0114	0.0232	0.0269	-0.14
324	Footwear, except rubber or plastic	-0.0147	-0.0049	-0.0061	-0.08
331	Wood products, except furniture	-0.0156	0.0395	0.0381	0.28
371	Iron and steel	-0.0204	-0.0055	-0.0029	0.09
361	Pottery, china, earthenware	-0.0217	0.0211	0.0208	-0.15
355	Rubber products	-0.0245	0.0202	0.0312	0.23

Table I reports values for each 3-digit ISIC manufacturing industry for capital growth (CAPGR), sales growth (SALESGR), value added growth (VAGR), and external-finance dependence (EXTFIN). These measures are all based on U.S. data. The Data Appendix gives details on the construction of all measures.

Table II: Financial Development, Investment Opportunities and Industry Growth

			External Finance	
	OLS	Robust	OLS	Robust
	(1)	(2)	(3)	(4)
Finance X Investment Opportunities	0.3183	0.2927	0.2905	0.2261
[*FD X CAPGR*]	*(3.08)*	*(4.47)*	*(2.34)*	*(3.22)*
Finance X External Finance Dependence			0.0109	0.0146
[*FD X EXTFIN*]			*(1.28)*	*(3.09)*
Industry Share in Total Manufacturing			-0.1955	-0.0803
[*SHARE80i,c*]			*(3.79)*	*(3.47)*
adj. R-squared	0.284		0.299	
Countries	67	67	66	66
Observations	1607	1607	1589	1589
Country Fixed-Effects	Yes	Yes	Yes	Yes
Industry Fixed-Effects	Yes	Yes	Yes	Yes

The dependent variable is the annual growth rate of value added at the industry-country level for the period 1980-1989. The Finance X Investment Opportunities interaction is the product of industry-level investment opportunities (CAPGR) and country-level financial development (FD). The Finance X External Finance Dependence interaction is the product of industr level reliance on external finance (EXTFIN) and country level financial development (FD). SHARE indicates the industry share in total value added in manufacturing in 1980.

Columns (1) and (3) report OLS estimates. Columns (2) and (4) report robust regression results based on an iterative least-squares method that assigns lower weights to influential observations. The Data Appendix gives detailed variable definition and data sources. All specifications include country and industry fixed effects. Absolute values of t-statistics based on robust standard errors are reported in parenthesis below the coefficients.

Table III: Accounting for Mismeasured Investment Opportunities

Panel A -- Instrumental Variable (IV) Estimates

	IV	IV-R
	(1)	(2)
Finance X Investment Opportunities	1.0610	0.6312
[*FD X CAPGR*]	*(3.86)*	*(3.49)*
Countries	67	67
Observations	1607	1607
Industry Fixed-Effects	Yes	Yes
Country Fixed-Effects	Yes	Yes

Panel B -- Actual and Predicted Capital Growth in the United States

Dependent Variable: Investment Opportunities [*CAPGR*]	(1)	(2)
Predicted investment opportunities	0.4854	0.6782
	(3.54)	*(4.71)*
R-squared	0.325	0.420
F-score	12.55	22.15
Observations	28	28

Panel A reports instrumental variable (IV) coefficient estimates. The dependent variable is the annual growth rate of value added at the industry-country level for the period 1980-1989. The Finance X Investment Opportunities interaction is the product of industry-level investment opportunities (CAPGR) and country-level financial development (FD). This interaction is instrumented by an interaction between financial development and value added growth at the US level of financial development predicted using data on all countries except the US. In column (1) predictions (GLOPP) are based on estimating equation (15) in the main text using OLS. In column (2) predictions (RGLOPP) are based on estimating equation (15) with a robust regression approach that assigns lower weights to influential observations. For more information on the IV approach see Sections 2.2.2 and 4.1.2 in the main text.

Panel B columns report OLS coefficients of regressing industry capital growth in the US (CAPGR) on industry value added growth at the US level of financial development predicted using data on all countries except the US. In column (1) predictions (GLOPP) are based on estimating equation (15) using OLS. In column (2) predictions (RGLOPP) are based on estimating equation (15) with a robust regression approach that assigns lower weights to influential observations. The Data Appendix gives detailed variable definitions and data sources. All specifications include country and industry fixed effects. Absolute values of t-statistics based on robust standard errors are reported in parenthesis below the coefficients.

Table IV: Investment Opportunities and Measurement Error

Investment Opportunities Proxy:	Sales Growth [*SALESGR*]			Value Added Growth [*VAGR*]		
	OLS		IV	OLS		IV
	(1)	(2)	(3)	(4)	(5)	(6)
Finance X Sales Growth	-0.1523	0.1779	1.0567			
[*FD X SALESGR*]	*(0.93)*	*(1.85)*	*(3.76)*			
Finance X Value Added Growth				-0.0579	0.1689	0.9032
[*FD X VAGR*]				*(0.46)*	*(1.97)*	*(3.81)*
Finance X Investment Opportunities	0.4540			0.3761		
[*FD X CAPGR*]	*(2.55)*			*(2.43)*		
adj. R-squared	0.284	0.281		0.284	0.282	
Countries	67	67	67	67	67	67
Observations	1607	1607	1607	1607	1607	1607
Industry Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes

The dependent variable is the annual growth rate of value added at the industry-country level for the period 1980-1989. The Finance X Investment Opportunities interaction is the product of industry-level investment opportunities (CAPGR) and country-level financial development (FD). The Finance X Sales Growth interaction is the product of industry-level sales growth (SALESGR) and country-level financial development (FD). The Finance X Value Added Growth interaction is the product of industry-level value added growth (VAGR) and country-level financial development (FD).

Columns (1), (2), (4), and (5) report OLS estimates Columns (3) and (6) report instrumental variable estimates The instrument for industry-specific sales growth (in column (3)) and value added growth (in column (6)) is value added growth at the US level of financial development predicted using data on all countries except the US (GLOPP). For more information on the IV models, see the notes to Table III and Sections 2.2.2 and 4.1.2. The Data Appendix gives detailed variable definitions and data sources. All specifications include country and industry fixed effects. Absolute values of t-statistics based on robust standard errors are reported in parenthesis below the coefficients.

Table V: Accounting for Income Differences

	All countries		No Low Income Countries	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
Finance X Investment Opportunities	0.2662	0.7840	0.3063	0.8990
[*FD X CAPGR*]	*(2.49)*	*(3.21)*	*(3.10)*	*(4.38)*
Income X Investment Opportunities	0.0680	0.3612		
[*Y X CAPGR*]	*(0.89)*	*(2.02)*		
adj. R-squared	0.284		0.321	
Countries	67	67	54	54
Observations	1607	1607	1335	1335
Industry Fixed-Effects	Yes	Yes	Yes	Yes
Country Fixed-Effects	Yes	Yes	Yes	Yes

The dependent variable is the annual growth rate of value added at the industry-country level for the period 1980-1989. The Finance X Investment Opportunities interaction is the product of industry-level investment opportunities (CAPGR) and country-level financial development (FD). The Income X Investment Opportunities interaction is the product of industry-level investment opportunities (CAPGR) and country-level log of per capita GDP (Y).

In columns (1) and (2) estimation is performed in the full sample of 67 countries. In columns (3) and (4) we drop low income countries (following the World Bank classification; these countries are listed in footnote 11 in the main text). Columns (1) and (3) report OLS estimates. Columns (2) and (4) report instrumental-variable coefficients, where the Investment Opportunities interactions with Finance and Income are instrumented by interactions between value added growth at the US level of financial development predicted using data on all countries except the US (GLOPP) and the respective country-level variable. For more information on the IV models, see the notes to Table III and Sections 2.2.2 and 4.1.2. The Data Appendix gives detailed variable definitions and data sources.

All specifications include country and industry fixed effects. Absolute values of t-statistics based on robust standard errors are reported in parenthesis below the coefficients.

Table VI: Alternative Adjustment Channels

	Legal System Quality (LAW)				Property Rights (PROP)				Schooling (SCH)			
	OLS		IV		OLS		IV		OLS		IV	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Finance X Invest. Opport.		0.3193		1.0782		0.2906		0.9893		0.3336		1.1836
[*FD X CAPGR*]		*(2.66)*		*(3.47)*		*(2.72)*		*(3.96)*		*(3.24)*		*(4.61)*
Law X Invest. Opport.	-0.1891	-0.0472	-0.4760	0.0040								
[*LAWINEF X CAPGR*]	*(2.40)*	*(0.52)*	*(3.06)*	*(0.02)*								
Property X Invest. Opport.					0.1805	0.0925	0.4020	0.0985				
[*PROP X CAPGR*]					*(2.63)*	*(1.31)*	*(1.96)*	*(0.51)*				
Schooling X Invest. Opport.									0.0469	0.0162	0.1389	0.0319
[*SCH X CAPGR*]									*(1.96)*	*(0.70)*	*(2.15)*	*(0.56)*
adj. R-squared	0.307	0.311			0.283	0.286			0.288	0.292		
Countries	58	58	58	58	65	65	65	65	63	63	63	63
Observations	1481	1453	1481	1453	1572	1572	1572	1572	1552	1552	1552	1552
Industry Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The dependent variable is the annual growth rate of value added at the industry-country level for the period 1980-1989. The Finance X Investment Opportunities interaction is the product of industry-level investment opportunities (CAPGR) and country-level financial development (FD). The Law X Investment Opportunities interaction is the product of industry-level investment opportunities (CAPGR) and a country-level measure of legal system (court) inefficiency (LAWINEF). The Property Rights X Investment Opportunities interaction is the product of industry-level investment opportunities (CAPGR) and a country-level measure of property rights protection (PROP). The Schooling X Investment Opportunities interaction is the product of industry-level investment opportunities (CAPGR) and country-level average years of schooling (SCH).

Columns (1), (2), (5), (6), (9) and (10) report OLS coefficients. Columns (3), (4), (7), (8), (11) and (12) report instrumental-variable coefficients, where the Investment Opportunities interactions with Finance, Legal Inefficiency, Property Rights Protection and Schooling are instrumented by interactions between value added growth at the US level of financial development predicted using data on all countries except the US (GLOPP) and the respective country level variable. For more information on the IV models, see the notes to Table III and Sections 2.2.2 and 4.1.2. All specifications include country and industry fixed effects. Absolute values of t-statistics based on robust standard errors are reported in parenthesis below the coefficients. The Data Appendix gives detailed variable definitions and data sources.

Table VII: Endogeneity of Financial Development and Mismeasured Investment Opportunities

	Double IV	Double IV-R
	(1)	(2)
Finance X Investment Opportunities	0.7206	0.6429
[*FD X CAPGR*]	*(2.53)*	*(2.70)*
Countries	67	67
Observations	1607	1607
Industry Fixed-Effects	Yes	Yes
Country Fixed-Effects	Yes	Yes

The dependent variable is the annual growth rate of value added at the industry-country level for the period 1980-1989. The Finance X Investment Opportunities interaction is the product of industry-level investment opportunities (CAPGR) and country-level financial development (FD).

All models report instrumental variable coefficients, where we instrument both parts of the interaction term between country-level financial development and industry-level investment opportunities. The instrument is obtained by interacting legal origin dummy variables (Legal Origin) with value added growth at the US level of financial development predicted using data on all countries except the US. In column (1) predictions (GLOPP) are based on OLS. In column (2) predictions (RGLOPP) are based on a robust regression approach that assigns lower weights to influential observations. For more information on the IV models, see the notes to Table III and Sections 2.2.2 and 4.1.2. The Data Appendix gives detailed variable definitions and data sources. All specifications include country and industry fixed effects. Absolute values of t-statistics based on robust standard errors are reported in parenthesis below the coefficients.