Human Capital, the Structure of Production, and Growth

Antonio Ciccone and Elias Papaioannou*

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Abstract

Do high levels of human capital foster economic growth by facilitating technology adoption? If so, countries with more human capital should have adopted more rapidly the skilled-labor augmenting technologies becoming available since the 1970's. High human capital levels should therefore have translated into fast growth in more compared to less human-capital-intensive industries in the 1980's. Theories of international specialization point to human capital accumulation as another important determinant of growth in human-capital-intensive industries. Using data for a large sample of countries, we find significant positive effects of human capital levels and human capital accumulation on output and employment growth in human-capital-intensive industries.

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* Antonio Ciccone, ICREA and Universitat Pompeu Fabra, Department of Economics and Business, Ramon Trias Fargas 25-27, 08005 Barcelona, Spain. Email: antonio.ciccone@upf.edu. Elias Papaioannou, European Central Bank, Financial Research Division, Postfach 160319, D-60066, Frankfurt, Germany. Email: elias.papaioannou@ecb.int. We thank Joshua Angrist, Francesco Caselli, Helmut Forstner, Christos Genakos, Victor Lavy, Greg Siourounis, Jaume Ventura, and David Weil for comments, Stijn Claessens, Raymond Fisman, Luc Laeven, and Inessa Love for kindly making their data available to us, and Pablo Fleiss and Giovanni Peri for helping us with the UNIDO and the Integrated Public Use Microdata Series databases respectively. We also thank seminar participants at CRETE, ESSIM, Hebrew University, UNIDO, IIES Stockholm and Vienna IHS. Part of the paper was written while Papaioannou was a doctoral student at the Economics Department of the London Business School. Partial financial support from the CREI research institute, the European Fund for Regional Development and the Fundación Caixa Galicia, the FBBVA, and the UNIDO research project on growth and productivity performance is gratefully acknowledged. The opinions expressed herein are those of the authors and do not necessarily represent those of the European Central Bank or the Eurosystem. All remaining errors are our responsibility.

1 Introduction

Following Barro (1991) and Mankiw, Romer, and Weil (1992), there has been an upsurge of empirical research on the effects of human capital on economic growth. The main issues analyzed are whether higher levels of education or greater improvements in education are associated with faster output growth. Overall, the cross-country evidence is mixed on both counts (notwithstanding the emphasis on human capital in new growth theories and recent neoclassical growth theories).[1] This could be because of difficulties when specifying cross-country growth regressions (Temple, 1999; Durlauf, Johnson, and Temple, 2005). For example, the limited number of countries forces researchers to use parsimonious specifications to avoid the degrees of freedom problem. Another reason could be attenuation bias due to mismeasured schooling data (Krueger and Lindahl, 2001; Cohen and Soto, 2001; de la Fuente and Domenech, 2001, 2005). Such attenuation bias could be magnified by multicollinearity, often present in cross-country growth regressions, as high-growth countries tend to have higher rates of human capital accumulation, deeper financial markets, stronger property rights protection, higher savings and investment rates etc. (Mankiw, 1995; Rajan and Zingales, 1998). Mixed results could also be due to schooling indicators used in empirical work often missing cross-country differences in educational quality (Hanushek and Kimko, 2000; Barro, 2001). In any case, a significantly positive correlation between schooling and output growth does not imply that schooling affects growth. Instead, both schooling and output growth could be driven by an omitted variable, total-factor-productivity growth for example (Bils and Klenow, 2000).

One way to progress in our understanding of the effects of human capital on growth is to focus on channels through which such effects could work. It is often argued that high levels of human capital facilitate technology adoption (e.g. Nelson and Phelps, 1966; Barro, 1991; Benhabib and Spiegel, 1994, 2002; Acemoglu, 2003a; Caselli and Coleman, 2005). There is a consensus that new technologies becoming available since the 1970's tended to be

[1] The empirical studies of Romer (1990a), Barro (1991), and Benhabib and Spiegel (1994) find a significantly positive effect of schooling levels on output growth, while Cohen and Soto (2001) find no link. Temple (1999), Cohen and Soto (2001), and de la Fuente and Domenech (2001, 2005) find a significantly positive correlation between improvements in education and growth, while Benhabib and Spiegel (1994), Barro and Sala-i-Martin (1995), Caselli, Esquivel, and Lefort (1996), and Pritchett (1997) find no effect of schooling improvements on growth. Topel (1999) and Krueger and Lindahl (2001) find both education level and improvement effects on growth. Examples of endogenous growth theories emphasizing human capital are Lucas (1988) and Romer (1990b). Mankiw, Romer, and Weil (1992) incorporate human capital into a neoclassical growth model.

more skilled-labor augmenting than the technologies of the 1950's and 1960's (e.g. Autor, Katz, and Krueger, 1998; Berman, Bound, and Machin, 1998; Berman and Machin, 2000; Caselli and Coleman, 2002). The defining characteristic of skilled-labor augmenting technologies is that they increase the productive efficiency of skilled relative to unskilled workers. Skilled-labor augmenting technologies therefore result in faster total-factor-productivity (TFP) growth in human-capital-intensive industries (e.g. Kahn and Lim, 1998; Klenow, 1998). As a result, countries adopting new technologies quickly should experience fast output growth in human-capital-intensive industries once other factors affecting growth are controlled for. If high levels of human capital facilitate technology adoption, output growth in human-capital-intensive industries should be faster in economies with high levels of human capital. We therefore test whether countries with higher education levels experienced faster growth in more compared to less schooling-intensive industries in the 1980's. Theories of international specialization point to human capital accumulation as another important determinant of growth in human-capital-intensive industries (e.g. Ventura, 1997, 2005; Romalis, 2004). Hence, we also examine the link between improvements in education and growth in schooling-intensive industries.

We investigate such human capital level and accumulation effects using data for 37 manufacturing industries in around 40 countries. Our empirical analysis builds on the framework and data of Rajan and Zingales (1998) and subsequent contributions to the finance and industry growth literature (e.g. Claessens and Laeven, 2003; Fisman and Love, 2003, 2004). We follow this literature in using U.S. data to obtain the industry-characteristics necessary for the empirical analysis. In particular, we use detailed 1980 U.S. Census data to calculate indicators of cross-industry differences in human capital intensity. These indicators allow us to test whether high levels of human capital and rapid human capital accumulation were associated with fast growth in human-capital-intensive industries.

We find statistically robust and economically significant support for the human capital level effect. To get a sense for its size, consider the annual output growth differential between an industry with a schooling intensity at the 75th percentile (Chemicals) and an industry at the 25th percentile (Pottery). When we measure levels of human capital using schooling quality indicators, our estimates imply that this growth differential is 1.3% − 2.1% higher in a country with schooling quality at the 75th percentile (e.g. Malaysia) than a country with schooling quality at the 25th percentile (e.g. Philippines). For comparison, the average growth rate of value added in our sample is 3.4% and the median growth rate is 2.9%.

When we proxy human capital levels using average years of schooling, the implied Chemicals-Pottery growth differential is $1.1\% - 1.8\%$ greater in countries with average schooling in 1980 at the 75th percentile (e.g. Japan with 8.2 years of schooling) than countries with average schooling at the 25th percentile (e.g. Portugal with 3.3 years). In line with recent findings in the cross-country growth literature (Hanushek and Kimko, 2000; Barro, 2001; Hanushek, 2004), schooling quantity levels often become only marginally significant or insignificant when schooling quality is accounted for.

We also find statistically robust and economically significant support for the human capital accumulation effect. For example, our estimates imply that the annual Chemicals-Pottery growth differential is $1\% - 1.2\%$ greater in countries with improvements in average schooling over the 1970-1990 period at the 75th percentile (e.g. Philippines with an improvement of 2.3 years) than countries with improvements at the 25th percentile (e.g. Sri Lanka with 1.1 years).

Our estimates of the impact of human capital on growth in human-capital-intensive industries control for country-specific and industry-specific effects. Industry effects capture movements in prices and technological innovation at the industry level. Country effects capture factors that determine growth at the country level (e.g. economic policy, social norms, political stability). Such factors are likely to also impact human capital accumulation. For example, economic reform may combine measures that stimulate economic growth with policies that foster education (Krueger and Lindahl, 2001). Moreover, as shown by Bils and Klenow (2000), all factors causing rapid TFP growth raise the return to human capital accumulation and therefore lead to education investments. Omitting country-specific effects may therefore result in upward biased estimates of the impact of human capital on growth.

Our empirical analysis jointly considers the growth effects of human capital and those of financial markets and property rights protection emphasized in the finance and industry growth literature. This allows us to check the robustness of industry growth effects of financial development and property rights protection to controls for human capital and vice versa. We find that financial development and property rights protection continue to have disproportionate growth effects in industries that depend on external finance (Rajan and Zingales, 1998) and use intangible assets intensively (Claessens and Laeven, 2003) respectively. The magnitude of such effects drops by $15\% - 40\%$ however. Industry growth effects of financial development working through dependence on trade credit and inter-industry resource reallocation (Fisman and Love, 2003, 2004) remain nearly unchanged.

The international specialization implication of the human capital level-technology adoption connection that we test is: high human capital –> rapid (skilled-labor augmenting) technology adoption –> fast output growth in schooling-intensive industries. To test whether faster output growth in human-capital-intensive industries coincides with the reallocation of production factors, we add country-industry level employment growth statistics to the finance and industry growth database. This data yield very robust support for a positive link between employment shifts to schooling-intensive industries and initial levels of human capital.

We also examine the effects of high human capital levels and rapid human capital accumulation on growth in human-capital-intensive industries separately in countries with low and countries with high tariffs. In countries with low tariffs, we find positive and statistically significant effects of education levels and improvements on output growth in schooling-intensive industries. As pointed out by Ventura (1997), it is such shifts in the production structure that allow open economies to avoid falling returns to human capital. In countries with high tariffs, the effects of education levels and improvements on output growth in schooling-intensive industries are often statistically insignificant.

The remainder of the paper is structured as follows. Section 2 presents a model that illustrates the effects of human capital on growth in more compared to less human-capital-intensive industries. Section 3 explains the sources and main features of our data. Section 4 presents our main empirical results. Section 5 contains additional evidence. In Section 6, we consider additional robustness checks. Section 7 concludes.

2 Theoretical Framework

We now explain how a country's capacity to adopt world technologies, which following Nelson and Phelps (1966) we assume depends on its human capital, may affect production in human-capital-intensive industries. Our theoretical framework links human capital and industry production both in steady state and during the transition to a new steady state triggered by an acceleration of skilled-labor augmenting technical change. This allows us to illustrate the positive effect of initial human capital on output growth in human-capital-intensive industries during such a transition.

The world consists of many open economies, indexed by c, that can produce in two industries, indexed by $s = 0, 1$. There are two types of labor, high and low human capital, and we denote their supply in country c at time t by $M_{c,t}$ and $L_{c,t}$ respectively. The efficiency levels $A^L_{c,t}$ and $A^M_{c,t}$ of the two types of labor evolve over time and depend on each country's capacity to adopt world technologies. Following Nelson and Phelps (1966), we assume efficiency growth $\hat{A}^f_{c,t} = \left(\partial A^f_{c,t}/\partial t\right)/A^f_{c,t}$ of labor of type $f = L, M$ (hats indicate growth rates) to be increasing in the gap between country efficiency $A^f_{c,t}$ and world-frontier efficiency $A^{f,W}_t$ (W indicates the world frontier),

$$\hat{A}^f_{c,t} = \phi^f\left(H_{c,t}\right)\left(\frac{A^{f,W}_t - A^f_{c,t}}{A^f_{c,t}}\right) \tag{1}$$

where $\phi^f(H)$ captures the country's capacity of technology adoption, which is increasing in its human capital $H \equiv M/L$. The only difference between this framework and that of Nelson and Phelps is that we distinguish between technologies augmenting the efficiency of high and low human capital workers, as in the literature on skill-biased and directed technical change (e.g. Acemoglu, 1998, 2003a; Acemoglu and Zilibotti, 2001; Caselli and Coleman, 2002, 2005).[2]

Output $X_{s,c,t}$ in industry s and country c at time t is produced according to $X_{s,c,t} = D_{c,t}E_{s,t}(A_{c,t}L)^{1-s}(A_{c,t}M)^s$ where D captures country-level efficiency and E industry-specific technology. Hence, industry 1 uses only high human capital labor, while industry 0 uses only low human capital labor. This extreme assumption regarding factor intensities simplifies our analysis, but is not necessary for the implications that follow.

To examine how steady-state production levels depend on a country's capacity to adopt technologies we suppose constant efficiency growth at the world-frontier, $\hat{A}^{L,W}_t = g^L$ and $\hat{A}^{M,W}_t = g^M$. Each country's human capital H_c, and hence its capacity to adopt technologies (ϕ^L_c and ϕ^M_c), are assumed to be constant in time. In steady state, efficiency in each country grows at the same rate as at the world-frontier. Equation (1) therefore implies that the steady-state level of efficiency of labor of type $f = L, M$ in country c is $A^{f*}_{c,t} = \frac{\phi^f_c}{g^f + \phi^f_c} A^{f,W}_t$ (asterisks denote steady-state values). Hence, the greater the capacity of countries to adopt technologies, the closer their steady-state efficiency levels to the world-frontier. It is now immediate to determine steady-state output in sector s in country c as

[2] Acemoglu (2003b) discusses the relationship between the Nelson and Phelps model and the literature on directed technical change.

(2) $$X^*_{s,c,t} = D_{c,t}E_{s,t}L_{c,t}\left(\frac{\phi^L_c}{g^L+\phi^L_c}A^{L,W}_t\right)^{1-s}\left(\frac{\phi^M_c}{g^M+\phi^M_c}A^{M,W}_t H_c\right)^s$$

where we have assumed that competitive labor markets ensure full employment. Steady-state production in the high relative to the low human capital industry, $Z^*_{c,t} \equiv X^*_{1,c,t}/X^*_{0,c,t}$, in country c as compared to q is therefore

(3) $$\frac{Z^*_c}{Z^*_q} = \left[\frac{H_c}{H_q}\right]\left[\frac{\left(\phi^M_c/\phi^L_c\right)\left(\frac{g^L+\phi^L_c}{g^M+\phi^M_c}\right)}{\left(\phi^M_q/\phi^L_q\right)\left(\frac{g^L+\phi^L_q}{g^M+\phi^M_q}\right)}\right].$$

This expression does not depend on country-level efficiency because we are comparing two industries within each country; it does not depend on industry-level technology because we are comparing the same industries in different countries.

Equation (3) implies that country c's human capital H_c has a factor supply effect and a technology adoption effect on its steady-state production structure as compared to country q. The factor supply effect (captured by the first square bracket) is straightforward. An increase in human capital means an increase in the relative supply of the factor used by the human-capital-intensive industry and therefore relatively greater production in the human-capital-intensive industry. The focus of our theoretical framework is on the technology adoption effect (captured by the second square bracket). This effect can reinforce the factor supply effect or work in the opposite direction, depending on whether it is skilled or unskilled-labor-augmenting technology that is progressing faster at the world frontier. For example, consider the case where human capital has the same impact on the capacity to adopt skilled and unskilled-labor augmenting technologies, $\phi^M(H) = \phi^L(H)$ for all H. Suppose first that skilled-labor augmenting technical progress at the world frontier exceeds unskilled-labor augmenting technical progress, $g^M > g^L$. In this case, a higher level of human capital H_c will translate into more human-capital-intensive production in the long run through the technology adoption effect. This is because human capital facilitates the adoption of all technologies equally and it is skill-augmenting technology that is advancing more rapidly at the frontier. Now suppose instead that $g^L > g^M$. In this scenario it is unskilled-labor augmenting technology that is progressing faster at the frontier. The technology adoption effect of higher human capital levels will therefore shift production towards the low human capital industry.

We now suppose that skilled-labor augmenting efficiency growth g^M at the world frontier increases at some time T.[3] Equation (3) implies that this acceleration of skilled-labor augmenting technical change translates into an increase in Z_c^*/Z_q^* if and only if $H_c > H_q$. Countries with high levels of human capital will therefore experience an increase in steady-state production levels in the human-capital-intensive industry relative to countries with low human capital. As a result, they will see relatively faster growth in the human-capital-intensive industry during the transition to the new steady state.[4] Formally, using lower-case variables to denote logs of upper-case variables,

$$\Delta z_c - \Delta z_q \equiv [z_{c,t} - z_{c,T}] - [z_{q,t} - z_{q,T}] = g(\underset{+}{h_{c,T}}) - g(\underset{+}{h_{q,T}}) \tag{4}$$

for $t > T$, where $g(h)$ is strictly increasing in h. Value added in each industry is $Y_{s,c,t} \equiv P_{s,t}X_{s,c,t}$ where $P_{s,t}$ denotes international prices. The production function implies that growth of value added between T and t equals $\Delta y_{s,c,t} \equiv y_{s,c,t} - y_{s,c,T} = \Delta d_c + \Delta l_c + \Delta p_s + \Delta e_s + s\Delta a_c^M + (1-s)\Delta a_c^M$. Combined with (4) this yields

$$\Delta y_{s,c} = \underbrace{[\Delta d_c + \Delta l_c]}_{\lambda_c} + \underbrace{[\Delta p_s + \Delta e_s]}_{\mu_s} + \eta + g(\underset{+}{h_{c,T}})s. \tag{5}$$

The country-specific effect λ_c captures country-level labor-force and total-factor-productivity growth, while the industry-specific growth effect μ_s is the sum of price changes and industry-specific technical progress. η captures unskilled-labor augmenting technical change. According to (5), the impact of initial human capital on growth during the transition is greater in the human-capital-intensive industry.[5] This is what we refer to as the human capital level effect on output growth in human-capital-intensive industries.

[3] For evidence that there was such an acceleration sometime around the early 1970's, see Autor, Katz, and Krueger (1998), Berman, Bound, and Machin (1998), Berman and Machin (2000), and Caselli and Coleman (2002). We take this acceleration to be exogenous. See Acemoglu (1998, 2002) and Acemoglu and Zilibotti (2001) for models that endogenize the rate of directed technical change at the technology frontier.

[4] This is because they adopt new skill-augmenting technologies more rapidly. Many of the new technologies becoming available since the 1970's were embodied in computers. Faster technology adoption in countries with high human capital levels should therefore have been accompanied by greater computer imports. This is what Caselli and Coleman (2001) find for the 1970-1990 period.

[5] During the transition, the TFP growth differential between the high and the low human capital industry is greater in a country with high than a country with low human capital. Our framework does not make predictions about whether this TFP growth differential is positive or negative. The evidence on the link between human capital intensity and TFP growth across U.S. industries is mixed. While there appears to be a positive link in the late 1970's and early 1980's (Kahn and Lim, 1998), there is no such relationship over longer periods (Klenow, 1998).

So far we have assumed that human capital in each country is constant in time. As a result, human capital affects industry output growth only through technology adoption in (5). When human capital levels increase in time there is also a factor supply effect.[6] As industries are assumed to be at opposite extremes in terms of their human capital intensity, this effect takes a particularly simple form in our framework. A one percent increase in human capital leads to a one-point output growth differential between the high and the low human capital industry over the same time period. With non-extreme factor intensities, the implied output growth differential would be larger (e.g. Ventura, 1997). This is because an increase in human capital would lead to labor moving from the less to the more human capital intensive industry (assuming the economy is not fully specialized). We refer to the positive effect of factor supply on output growth in human-capital-intensive industries as the human capital accumulation effect.

The factor supply effect linking human capital and relative production levels in the human-capital-intensive industry in (3) does not carry through to single industry pairs in a neoclassical multi-industry model. It can be shown, however, that human capital abundant countries will still specialize in human-capital-intensive industries on average (e.g. Deardorff, 1982; Forstner, 1985). Furthermore, as shown by Romalis (2004), the positive effect of human capital abundance on relative production levels in human-capital-intensive industries reemerges for single industry pairs once monopolistic competition and transport costs are incorporated into an otherwise standard neoclassical multi-industry model.[7]

3 Data

Data on real growth of value added during the 1980's at the country-industry level ($GROWTH_{s,c}$) come from the finance and industry growth literature (e.g. Rajan and Zingales, 1998; Claessens and Laeven, 2003; Fisman and Love, 2003, 2004) and have originally been put together by Rajan and Zingales (henceforth RZ) using the Industrial Statistics of the United Nations Industrial Development Organization. The data refer to 37 industries in 42 coun-

[6] Increases in human capital could also affect industry output growth through technology adoption. Such effects are likely to be small in our empirical application because it takes time for additional human capital to translate into new technologies.

[7] Romalis (2004) integrates the Dornbusch, Fischer, and Samuelson (1980) two-factor multi-industry Heckscher-Ohlin model with Krugman's (1980) trade model with monopolistic competition and trade costs. He shows that this yields cogent theoretical foundation for cross-country cross-industry comparisons.

tries.[8] We match this data with country-industry employment growth during the 1980's ($EMPGR_{s,c}$) using the latest update of the Industrial Statistics (UNIDO, 2004).[9] The Data Appendix contains a list of the countries in the sample and also provides detailed definitions and sources for all variables.

The finance and growth literature is also the source of the industry-level data needed to account for the effects of financial development and property rights protection on industry growth. RZ argue that financial development should matter most for external-finance-dependent industries. To test this hypothesis they develop an industry-level measure of external-finance dependence ($EXTFIN$) using COMPUSTAT financial statement data for U.S. firms in the 1980's. Claessens and Laeven (2003) use the same data source to obtain a measure of the intangible asset intensity of industries ($INTANG$) and show that intangible-asset-intensive industries grow faster in countries with better property rights protection. Additional industry characteristics will be discussed as we use them.

Our industry-level measure of human capital intensity is also based on U.S. data. The main reason is the detail and quality of U.S. industry statistics. Another reason is that U.S. labor markets are less regulated than those of other high-income countries for which some industry data are available (Djankov et al., 2004). Observed differences in human capital intensities across industries are therefore likely to better reflect underlying technological characteristics of industries. Moreover, as we examine the role of human capital for industry growth jointly with that of finance and property rights, it is natural to maintain the same benchmark country for industry-level measures as the finance and industry growth literature. Using U.S. data to proxy for differences in human capital intensities across industries in all other countries does have drawbacks. Most importantly, it could lead us to reject our hypotheses linking country-level human capital to growth in human-capital-intensive industries not because they are false but because U.S. data does not yield good proxies for cross-industry differences in human capital intensities in other countries. What matters for avoiding such a false negative is that differences in the human capital intensity across U.S. industries reflect inter-industry differences in human capital intensities in other countries. It is not necessary for industries to use human capital with the same intensity in different countries.

[8] The data is at the 3 and 4-digit International Standard Industrial Classification level. RZ do not include the U.S. in their sample because all necessary industry characteristics are obtained using U.S. data.

[9] Employment growth refers to the 1981-1990 period (while the output growth data refers to the 1980-1989 period), because the UNIDO database does not contain much employment data before 1980.

The data source for our industry-level measure of human capital intensity is the 1980 Integrated Public Use Microdata Series. This database contains individual-level data on hours worked by 4-digit industry classifications and years of education. This allows us to calculate average years of employee schooling ($HCINT$) for all industries in the RZ sample.[10] Table I reports the schooling intensity for all industries. The two most schooling-intensive industries are Drugs and Computing and the two least schooling intensive are Leather and Apparel.[11] Table II, Panel A gives the correlation between $HCINT$ and the industry-level rankings used in studies on finance and industry growth. It can be seen that schooling-intensive industries also tend to rely more on external finance (the correlation between $HCINT$ and $EXTFIN$ is 0.56). Hence, controlling for industry schooling intensity may be important to precisely quantify the differential growth effect of deeper financial markets on external-finance-dependent industries.

Average years of schooling at the country level (SCH) is taken from the Barro and Lee (2001) database. For completeness and to address issues related to measurement error we also employ the schooling dataset of Cohen and Soto (2001). Starting with Hanushek and Kimko (2000), recent work (e.g. Barro, 2001; Bosworth and Collins, 2003) has found that schooling quality is an important determinant of economic growth. Hanushek and Kimko collect data on the results of internationally administered tests in mathematics and sciences and process the data to make them comparable across years and countries. This data is then used to obtain a measure of country schooling quality. We use this schooling quality measure as extended and updated by Bosworth and Collins (2003). Following Hanushek and Kimko, we refer to this human capital measure as labor-force quality ($LFQUAL$).

Country-level financial development measured as private credit over GDP ($PRIV$) and the indicator of property rights protection ($PROP$) are taken from Fisman and Love (2003) and Claessens and Laeven (2003) respectively.[12] Other country-level variables come from standard sources. Table II, Panel B gives the correlation between the main country-level variables. It can be seen that higher education levels go together with deeper financial

[10] We also calculate the share of employees with at least 12 years of education (necessary for completing secondary school) and at least 16 years of education (college), $HCINT(SEC)$ and $HCINT(COLL)$ respectively. Table II, Panel A shows that the correlations with average schooling are above 0.92.

[11] An often used measure of industry human capital intensity is the share of non-production workers in total employment ($NONPROD$). Table II, Panel A shows that the correlation between $NONPROD$ and $HCINT$ is high (0.87).

[12] Private credit to GDP is an often used proxy of financial depth (e.g. Djankov, McLiesh, and Shleifer, 2005). We also try other proxies like stock market capitalization to GDP and domestic credit to GDP. All our results are robust to using these alternative indicators.

markets (the correlation between SCH and $PRIV$ is 0.41). This is another reason why controlling for education may be important to precisely quantify the differential effect of financial development on industry growth. Education levels are also significantly positively correlated with property rights protection (the correlation between SCH and $PROP$ is 0.61).

4 Main Results

We start by examining whether countries with high levels of human capital experienced fast output growth in more compared to less human-capital-intensive industries in the 1980's. Then we turn to the hypothesis that growth in human-capital-intensive industries was positively related to human capital accumulation. We conclude by examining the two hypotheses jointly.

4.1 Human Capital Levels and Industry Growth

We test for the effect of human capital levels on growth in human-capital-intensive industries using the following estimating equation:

$$(6) \qquad \Delta y_{s,c,1990-1980} = \lambda_c + \mu_s + \delta \left(h_{c,1980} * HCINT_s \right) + OtherControls$$

where the dependent variable is real valued added growth in industry s in country c ($GROWTH_{s,c}$). $HCINT_s$ denotes the human capital intensity of industries and h_c the human capital level of countries. λ_c and μ_s are country and industry-specific growth effects respectively. $OtherControls$ comprises interactions between industry and country-characteristics used to capture the differential industry growth effects of finance and property rights protection. It also includes the share of industry s in total manufacturing value added of country c at the beginning of the sample ($FRACT_{s,c}$), which RZ and subsequent contributions to the finance and industry growth literature use to account for initial conditions. There is a human capital level effect on output growth in human-capital-intensive industries in (6) if $\delta > 0$.

The results of estimating (6) are reported in Table III. t-statistics adjusted for heteroskedasticity are reported in parentheses and italics below the point estimates. In columns (1)-(4) human capital levels are proxied with Barro-Lee average years of schooling (SCH) in 1980. The estimate of δ in column (1) is 0.0034 and highly statistically significant. This coefficient implies an annual growth differential of 1.77% between the industry at the 75th percentile (Chemicals) and the 25th percentile (Pottery) of human capital intensity in a country with average schooling years at the 75th percentile (e.g. Japan) compared to a country at the 25th percentile (e.g. Portugal). This implied growth differential is tabulated for all specifications in the bottom row of the Table. The education level effect is somewhat larger in magnitude than the (analogously calculated) unconditional effect of financial development on growth in external-finance-dependent industries documented by RZ (0.9%-1.3%). It is also somewhat larger than Claessens and Laeven's (2003) unconditional effect of property rights protection on growth in industries that use intangible assets intensively (1%-1.4%).

In columns (2)-(4) we estimate the effect of high levels of schooling on growth in schooling-intensive industries controlling for the role of financial development and property rights protection for growth in external-finance-dependent and intangible-asset-intensive industries respectively. The positive impact of human capital levels on growth in human-capital-intensive industries is robust to the inclusion of the RZ finance interaction ($PRIV_c * EXTFIN_s$) in column (2) and the inclusion of the Claessens and Laeven (2003) property rights interaction ($PROP_c * INTANG_s$) in column (3). When we control for both the finance and the property rights interactions in column (4) however, the human capital level effect drops by a third and becomes (marginally) insignificant.

To investigate the link between the effect of human capital levels on industry growth and industry human capital intensity in a more flexible way we implement the following two-step approach. In the first step we estimate the marginal effect of average years of schooling in 1980 on industry output growth separately for each industry. This is done by replacing $\delta h_c * HCINT_s$ in (6) with $\sum_i \delta_i h_c * I[i = s]$, where $I[i = s]$ is an indicator variable that is unity when i equals s and zero otherwise. In the second step we plot the estimated industry-specific marginal growth effects δ_s against industry schooling intensity ($HCINT_s$). The positive correlation between the two in Figure 1a indicates that high education levels were more important for growth in industries that employ schooling intensively. This relationship does not appear to be driven by a few industries only. The link is weaker in Figure 1b where we use estimates of marginal growth effects δ_s that control for the differential industry growth effects of financial development and property rights protection.

In columns (5)-(8), we proxy human capital levels with schooling quality. Columns (5) and (6) show that the schooling quality interaction with industry human capital intensity ($LFQUAL_c * HCINT_s$) enters positively and significantly at the 1% level, whether or not the differential industry growth effects of finance and property rights are accounted for. Hence, countries with a high quality labor force experienced relatively faster growth in human-capital-intensive industries. According to the estimate in column (6), the annual output-growth differential between an industry with a human capital intensity at the 75th percentile (Chemicals) and an industry with a human capital intensity at the 25th percentile (Pottery) is around 2% higher in a country with educational quality at the 75th percentile (e.g. Malaysia) than a country with educational quality at the 25th percentile (e.g. Philippines). Columns (7) and (8) show that the schooling quantity interaction becomes insignificant when human capital quality is taken into account. Our cross-country cross-industry growth results therefore add to the micro and cross-country evidence on the importance of human capital quality (e.g. Hanushek, 2004).

To examine the link between the marginal growth effect of schooling quality and industry schooling intensity in a more flexible way, we return to the two-step approach. We first estimate the effect of schooling quality on industry output growth allowing for different effects in each industry. In the second step we plot the estimated industry-specific effects against industry human capital intensity. The strong positive correlation between the two is evident in Figure 2a and also in Figure 2b where we control for the differential industry growth effects of financial development and property rights protection. Hence, schooling quality matters more for growth in industries that use schooling intensively. Moreover, the link does not seem to be driven by a few industries only.

4.2 Human Capital Accumulation and Industry Growth

To analyze the effect of human capital accumulation on growth in human-capital-intensive industries, we use an appropriately modified version of the two-step approach. We first estimate

$$\Delta y_{s,c,t} = \lambda_c + \mu_s + \sum_i \theta_i \Delta h_{c,1970-1990} * I[i = s] + OtherControls \tag{7}$$

where $\Delta h_{c,1970-1990}$ stands for the increase in average years of schooling at the country level between 1970 and 1990 and $I[i = s]$ takes the value one when i equals s and zero otherwise.[13] This estimating equation yields the effect of schooling improvements on growth for each industry (θ_s).[14] These effects can then be compared to the schooling intensity of industries to examine whether there is a (positive) relationship.

In Figure 3a, we plot each industry's human capital intensity ($HCINT_s$) against our estimates of the effect of improvements in country-level schooling on output growth in that industry. Figure 3b repeats the exercise using estimates of θ_s that control for the differential role of financial development and property rights protection for external-finance-dependent and intangible-asset-intensive industries respectively. Both figures show a clear positive relationship between the effect of human capital accumulation on output growth in an industry and that industry's human capital intensity. Hence, improvements in education were more important for growth in industries that employ schooling intensively.

To test the hypothesis of a positive link between human capital accumulation and growth in human-capital-intensive industries we estimate

$$\Delta y_{s,c,t} = \lambda_c + \mu_s + \theta\left(\Delta h_{c,1970-1990} * HCINT_s\right) + OtherControls. \tag{8}$$

Table IV reports the results for different sets of controls. The positive and highly statistically significant estimate of θ in columns (1)-(4) indicates that growth of more compared to less schooling-intensive industries was faster in countries with greater improvements in education. To get a sense for the size of this effect, consider the comparison between a country with an improvement in schooling over the 1970-1990 period at the 75th percentile (e.g. Philippines with an improvement of 2.3 years) and a country at the 25th percentile (e.g. Sri Lanka with an improvement of 1.1 years). According to the estimate of θ in column (4), the associated gap in annual output growth between Chemicals (with a schooling intensity at the 75th percentile) and Pottery (at the 25th percentile) is 1.11%. This implied growth differential is tabulated for all specifications in the bottom row of the Table.

The cross-country growth literature finds that the effect of human capital accumulation on output growth is sensitive to controlling for physical capital accumulation (e.g. Benhabib and Spiegel, 1994; Krueger and Lindahl, 2001). This has been attributed to measurement

[13] We use schooling improvements over the 1970-1990 period because of the evidence indicating that measurement error increases as shorter time-intervals are considered (e.g. Krueger and Lindahl, 2001). We present results for the 1980-1990 period in Section 6.

[14] For a survey of work estimating such unconstrained industry growth effects for several production factors see Harrigan (2001).

error in schooling data combined with human capital accumulation being highly positively correlated with physical capital accumulation (e.g. Mankiw, 1995; Krueger and Lindahl, 2001). We now examine whether the positive effect of human capital accumulation on growth in human-capital-intensive industries is sensitive to controls for the impact of physical capital accumulation. Country-level growth effects of physical capital accumulation are captured by country fixed effects in our framework. Physical capital accumulation could still affect our findings however, because it may interact with physical capital requirements of industries. In columns (5) and (6), we check on this possibility by adding an interaction between industry investment intensity ($INVINT_s$) and the increase in physical capital per worker at the country-level between 1970 and 1990 ($\Delta K_c/L_c$).[15] $INVINT$ comes from RZ and is defined as the ratio of capital expenditure to property plant and equipment of U.S. firms in the 1980's. In column (5), $INVINT_s * \Delta K_c/L_c$ enters positively and statistically significantly. In column (6), the investment interaction is rendered statistically insignificant by the inclusion of the RZ financial development and the Claessens and Laeven (2003) property rights protection interactions. Columns (5) and (6) show that the positive effect of schooling improvements on growth in schooling-intensive industries remains statistically significant at the 1% level and of the same magnitude as in previous specifications. This result is robust to using other measures of industry physical capital intensity or using country-level investment rates instead of changes in physical capital.[16]

Our results on the effect of human capital accumulation on the pattern of specialization in production fit nicely with Romalis' (2004) work. Romalis' theoretical framework yields that the impact of human capital accumulation on industry output and export growth is increasing in the industry's human capital intensity (a result he refers to as the quasi-Rybczynski prediction). He examines the prediction for exports using data on imports to the U.S. for the 1972-1998 period and finds that imports from countries experiencing rapid human capital accumulation did in fact grow most in human-capital-intensive industries.[17]

[15] We calculate the capital stock of countries using Penn World Table data and following the perpetual inventory method as implemented by Hall and Jones (1999) and Caselli (2005). The dates are chosen to make the treatment of physical capital symmetric to that of schooling.

[16] We experiment with three measures obtained from the latest update of the NBER-CES U.S. manufacturing industries database (Bartelsman and Gray, 1996). Capital stock over value added, capital stock over employment, and one minus the labor share in value added.

[17] Romalis' model also yields that human capital abundant countries specialize in human-capital-intensive industries (the quasi-Heckscher-Ohlin prediction). He finds that this prediction is also supported by U.S. import data. Fitzgerald and Hallack (2004) find support for the quasi-Heckscher-Ohlin prediction using production data for 21 OECD countries in 1988.

4.3 Joint Human Capital Accumulation and Level Effects

In Table V, we present the results of estimating jointly the human capital level effect and the human capital accumulation effect using

$$(9)\ \Delta y_{s,c,t} = \lambda_c + \mu_s + \delta\left(h_{c,1970} * HCINT_s\right) + \theta\left(\Delta h_{c,1970-1990} * HCINT_s\right) + OtherControls.$$

The results in columns (1) and (2) confirm our previous findings that growth in schooling-intensive industries is increasing in both initial years of schooling and improvements in schooling.[18] Point estimates are similar to those obtained in our previous analysis (and of higher statistical significance). For example, controlling for finance and property rights, the industry at the 75th percentile of human capital intensity is predicted to grow by 1.22% faster annually than the industry at the 25th percentile in a country with schooling improvements at the 75th percentile compared to a country at the 25th percentile. The analogously calculated growth differential for the schooling level effect is 1.27%.

In columns (3) and (4), we repeat the analysis using schooling quality instead of schooling years to measure human capital levels. The schooling quality and the schooling improvement interactions with industry human capital intensity are both positive and statistically significant. Point estimates are again similar to those obtained earlier.

In columns (5) and (6), we reexamine whether growth in human-capital-intensive industries is more closely related to human capital levels proxied with years of schooling or with schooling quality. The results confirm our previous finding that initial years of schooling turns insignificant when schooling quality is taken into account.

In columns (7) and (8), we add two interactions to capture possible differential effects of high physical capital levels and rapid physical capital accumulation on growth in investment-intensive industries. The first interaction, between the RZ industry-level investment intensity and the increase in physical capital per worker between 1970 and 1990, captures growth effects of physical capital accumulation on investment-intensive industries. The second interaction, between the RZ industry-level investment intensity and physical capital per worker in 1970, accounts for possible industry growth effects of high initial levels of physical capital. Both interactions are statistically insignificant. Most importantly from our point of view,

[18] As improvements in schooling refer to the 1970-1990 period, initial years of schooling is measured in 1970.

the human capital accumulation and the human capital level effects retain their statistical and economic significance. This is the case when human capital levels are proxied with years of schooling in column (7) and when they are proxied with schooling quality in column (8).[19]

The results in Table V confirm RZ's and Claessens and Laeven's (2003) argument that deep financial markets foster growth in external-finance-dependent industries and that good property rights protection generates growth in industries using intangible assets intensively. The two corresponding interactions are always positive and significant at conventional confidence levels. But the magnitude of these effects is smaller than in the previous literature. The estimate of the RZ finance interaction in Table V implies an annual output growth differential between an industry at the 75th percentile of external-finance dependence and one at the 25th percentile that is 0.85% higher in a country with financial development at the 75th percentile than a country at the 25th percentile. This effect is 60% − 65% of that reported by RZ and Claessens and Laeven. Regarding the role of property rights protection, our estimates predict that the output growth differential between an industry at the 75th percentile of intangible asset intensity and an industry at the 25th percentile is 0.85% − 0.95% higher in a country with a property rights protection index at the 75 percentile than a country at the 25th percentile. This growth differential is approximately 75% − 85% of that reported by Claessens and Laeven.

5 Further Evidence

We start by taking into account additional effects of financial development on industry growth. Then we examine the role of human capital using industry-level employment growth to measure changes in the pattern of specialization. We conclude by analyzing the effect of human capital on growth in human-capital-intensive industries separately in countries with low and high tariffs.

5.1 Financial Development, Human Capital and Industry Growth

In their recent contributions to the finance and industry growth literature, Fisman and Love (2003, 2004) identify additional effects of financial depth on growth. Fisman and Love (2003)

[19] These results are robust to using the three alternative measures of physical capital intensity at the industry level discussed in Footnote 16.

show that industries with easier access to trade credit grow relatively faster in countries with underdeveloped financial markets.[20] To check how their finding affects our estimates of the human capital level and accumulation effect, we include an interaction between country-level financial development and industry-level trade-credit affinity among the controls in (9). Industry trade-credit affinity ($TRADEINT$) is taken from Fisman and Love and is defined as the ratio of accounts payable to total assets of U.S. firms in the 1980's. The results are reported in Table VI, columns (1) and (2). The effects of education levels and improvements on growth in schooling-intensive industries remain statistically significant and of a similar magnitude as in previous specifications. This is the case whether human capital levels are proxied with years of schooling or schooling quality. The finance-trade credit interaction enters with a statistically significant negative coefficient; the magnitude of the effect is very close to that documented by Fisman and Love.

Fisman and Love (2004) show that deeper financial markets lead to rapid growth in industries with good prospects. To check the robustness of our findings to this additional link between financial development and industry growth, we add an interaction between financial development and industry growth opportunities to our regressions. The growth opportunities variable ($OPPORT$) is taken from Fisman and Love and is constructed using U.S. data on industry-level sales growth in the 1980's. Columns (3) and (4) show that the effects of human capital levels and human capital accumulation on growth in human-capital-intensive industries remain positive, statistically significant, and of a similar magnitude as in earlier specifications. Financial development has a significant positive effect on the growth of industries with good prospects and the magnitude of this effect is very close to that found by Fisman and Love. Like Fisman and Love, we find that accounting for the growth prospects channel linking financial development and industry growth renders the interaction between industry external-finance dependence and financial development statistically insignificant. Columns (5) and (6) jointly account for the trade-credit and growth-opportunities interaction with financial development. Both the human capital level and accumulation effect on growth in human-capital-intensive industries continue to be highly significant.[21]

[20] Theoretical work suggests that this is because trade credit and external finance are substitutes (e.g. Petersen and Rajan, 1997).

[21] Following RZ and Fisman and Love (2004), we also examine the sensitivity of our results to extreme observations by dropping the top and bottom one percent of output growth observations and using a robust regression approach. The coefficients on the human capital level and the human capital accumulation interactions remain positive and significant at the 1% level in both cases.

5.2 Human Capital and Industry Employment Growth

Did faster output growth in human-capital-intensive industries due to human capital level and accumulation effects coincide with the reallocation of employment? To address this question, we repeat our previous empirical analysis using employment growth ($EMPGR_{s,c}$) as the dependent variable. This allows us to test whether high levels of human capital and fast human capital accumulation were associated with rapid employment growth in human-capital-intensive industries.

There is an additional reason for checking our results using employment data to measure changes in international specialization. As shown by Krueger and Lindahl (2001), a positive effect of human capital levels on subsequent output growth in cross-country regressions could be due to a world-wide increase in the individual return to human capital (whatever its cause). Our results linking human capital levels to output growth in human-capital-intensive industries could therefore be partly driven by rising individual returns to education.[22]

Table VII presents the results of our employment growth regressions. The main finding is that the effects of human capital levels and human capital accumulation on employment growth in human-capital-intensive industries are positive and always significant at the 1% level. This is the case whether we proxy human capital levels with years of schooling in columns (1)-(4) or schooling quality in columns (5)-(8). The effect of human capital levels on employment growth is larger than on output growth. For example, consider the annual employment growth differential between an industry with a schooling intensity at the 75th percentile (Chemicals) and an industry at the 25th percentile (Pottery). When we proxy human capital levels with years of schooling, our estimates imply that this growth differential is around 1.7% higher in a country with schooling at the 75th percentile (e.g. Japan) compared to a country with schooling at the 25th percentile (e.g. Portugal). When we proxy human capital levels with schooling quality, the implied annual Chemicals-Pottery growth differential is 2% greater in countries with schooling quality at the 75th percentile (e.g. Malaysia) than countries with schooling quality at the 25th percentile (e.g. Philippines).[23] When included jointly in our regressions, both years of schooling and schooling quality are now significantly positively related to growth in schooling-intensive industries (results not in the Table). Interestingly, the employment growth regressions have a markedly higher

[22] We are grateful to Joshua Angrist and David Weil for discussions that clarified these points.

[23] The finance effects are usually weaker than in previous tables. This is not surprising as the finance-industry growth connection works through investment and capital deepening.

adjusted R^2 (around 43%) than the output growth regressions (around 26%, see Table VI). One explanation for this difference is that value added data are recorded with greater error than employment.[24]

5.3 Openness

We now examine the effects of high human capital levels and rapid human capital accumulation on growth in human-capital-intensive industries separately in countries with low and countries with high tariffs during the 1980's. The tariff data come from Sachs and Warner (1995) and the World Bank (the only two sources available). The World Bank data consist of an unweighted average of tariffs on all goods and the Sachs and Warner data of an import-weighted average of tariffs on intermediates and capital goods. Both average tariff series are therefore only very rough proxies for effective tariffs. In Table VIII, Panel A, we split economies into those with average tariffs during the 1980's below and above the median. Splitting the data this way results in the same number of low and high tariff countries. These tariff thresholds turn out to be rather low however. The median Sachs and Warner tariff is 11% and the median World Bank tariff is 15%. In Panel B, we therefore also split economies into those with average tariffs below and above 40%.[25]

In countries with low tariffs, we find that the effect of human capital accumulation on growth in human-capital-intensive industries is positive and significant at the 1% level in all specifications. The human capital level effect in low-tariff countries is also highly significant when we proxy human capital levels with schooling quality. Proxying human capital levels with schooling years yields a statistically significant human capital level effect at the 10% level in 3 out of 4 cases (the weaker human capital level effect using schooling years mirrors previous findings).

Our estimates of the human capital level and accumulation effect for high-tariff countries are noisier than for low-tariff countries, especially when we use the 40% tariff threshold.[26] As a result, such effects are often statistically insignificant. For example, the effect of human

[24] Both RZ and Fisman and Love (2004) note that the distribution of value added growth has rather long tails. For example, annual output growth at the 1st and 99th percentile is -30% and $+27\%$. The distribution of employment growth is more compact. For example, its standard deviation is only half that of output growth. Greater noise in the value added data could, for example, be due to the difficulties in deflating nominal value added, see RZ.

[25] Sachs and Warner use such 40% tariff threshold to classify economies into open and closed.

[26] This could be due to domestic industry demand shocks playing a bigger role for industry output growth in high-tariff countries.

capital accumulation on growth in human-capital-intensive industries is always insignificant in economies with tariffs above 40%.[27] In economies with tariffs above the median, the human capital accumulation effect is positive but insignificant at the 5% level in 3 out of 4 cases.[28] The human capital level effect is also statistically insignificant in high-tariff economies. We find similar results when we use employment growth to measure changes in the pattern of specialization (results not in the Table).

6 Sensitivity Analysis

We first examine the sensitivity of our results to the measurement of schooling improvements. Then we present estimates using an alternative specification for the link between human capital and years of schooling. We conclude by putting our output and employment growth results through further sensitivity checks.

6.1 Measurement of Schooling Improvements

We start by investigating the robustness of our results to using improvements in education between 1980 and 1990 as an explanatory variable. Then we examine whether our findings are sensitive to using the schooling series of Cohen and Soto (2001).[29] We also implement Krueger and Lindahl's (2001) approach to measurement error in schooling data.

Our results are summarized in Table IX. Estimates are conditional on the impact of financial development on growth in trade-credit-intensive industries, the impact of financial development on growth in industries with good prospects, and the impact of property rights protection on growth in intangible-asset-intensive industries.[30] In column (1), we measure

[27] Point estimates of the education level and improvement effect in countries with tariffs above 40% turn out to be very sensitive to the specification and/or estimation method used. For example, using a robust regression approach turns the (imprecise) positive effect of schooling quality on growth in schooling-intensive industries into a (imprecise) negative effect.

[28] The effect of human capital accumulation on the production of human-capital-intensive goods in closed economies can be positive, negative, or zero, depending on the price elasticities of demand (e.g. Ventura, 1997). None of the countries in our sample is closed to international trade. For example, trade over GDP in the 1980's in the 6 countries with highest tariffs is above 20% for all except India (the average including India is 34%; the Penn World Table average is 73%).

[29] The main differences between the Cohen-Soto and Barro-Lee datasets are that Cohen and Soto use more census observations, employ a different approach to extrapolate missing data, and change values they consider implausible.

[30] Results are not reported. The three corresponding interactions are significant at standard levels in nearly all specifications in Tables IX and X, Panel A. Our results are not sensitive to the inclusion of the interaction

human capital accumulation as schooling improvements over the 1980-1990 period instead of the 1970-1990 period. Accordingly we now use years of schooling in 1980 as initial human capital. Both the human capital level and accumulation effect remain highly statistically significant. In column (2), we report the results of estimating the same specification with the Cohen-Soto data. The human capital level and accumulation effect continue to be highly significant. In column (3), we follow the instrumental-variables strategy of Krueger and Lindahl (2001) to deal with measurement error. Krueger and Lindahl propose using one mismeasured schooling series as an instrument for another mismeasured series, since this eliminates attenuation bias when measurement errors are orthogonal. We use the Cohen-Soto schooling data as an instrument for the Barro-Lee data. In line with the findings of Krueger and Lindahl, instrumenting leads to larger human capital level and accumulation effects. Using employment growth to measure changes in the pattern of specialization yields similar results (not in the Table).

6.2 Alternative Functional Form

In the cross-country growth literature there is no consensus on how aggregate schooling measures should enter empirical analysis. In empirical labor economics it has been found that a log-linear earnings-schooling relationship performs well (see Card, 1999, for a review). Several macro-econometric studies have therefore adopted a log-linear model of the aggregate output-schooling relationship (e.g. Heckman and Klenow, 1998; Krueger and Lindahl, 2001).[31] Other macro studies use a log-log specification (e.g. Mankiw, Romer, and Weil, 1992; de la Fuente and Domenech, 2001). In Table VIII, columns (4)-(6), we reestimate the previous three columns using log years of schooling in 1980 as a proxy of initial human capital levels and the change in log schooling over the 1980-1990 period as a measure of human capital accumulation (we continue to control for interactions between financial development and trade-credit affinity, between financial development and growth opportunities, and between property rights protection and intangible-asset intensity). These specifications also yield support for both the human capital level and accumulation effect. We find similar results using the log schooling specification to explain employment growth across industries with different human capital intensities (not reported in the Table).

between financial development and industry external-finance dependence (which enters insignificantly once the growth prospects channel is accounted for).

[31] Our regressions so far assumed that log human capital h is linear in SCH and $LFQUAL$. Caselli (2005) uses and motivates this functional form in the (very different) context of development accounting.

6.3 Further Sensitivity Checks

Table X reports on a series of further sensitivity checks using both output growth (in Panel A) and employment growth (in Panel B) to measure changes in the pattern of specialization. All results continue to be conditional on the effect of financial development on growth in trade-credit-intensive industries, the effect of financial development on growth in industries with good prospects, and the effect of property rights protection on growth in intangible-asset-intensive industries.

In Panel A, columns (1)-(6), we investigate to what extent growth in human-capital-intensive industries is affected by high levels of economic development due to factors other than human capital. An important factor of development is investment in physical capital. Mankiw, Romer, and Weil (1992) and Klenow and Rodriguez-Clare (1997) demonstrate that the physical capital-output ratio isolates the role of investment for long-run productivity from that of TFP and human capital. In columns (1) and (2), we therefore include an interaction between the physical capital-output ratio and industry human capital intensity ($K_c/Y_c * HCINT_s$) in our regressions. In column (1), the interaction between years of schooling and industry schooling intensity turns statistically insignificant, while $K_c/Y_c * HCINT_s$ is significant at the 10% level. When human capital levels are proxied with schooling quality in column (2), it is $K_c/Y_c * HCINT_s$ that becomes insignificant, while the schooling quality interaction with industry schooling intensity is significant at the 5% level. The human capital accumulation effect is statistically significant at the 1% level in both specifications.

Acemoglu, Johnson, and Robinson (2001) show that property rights protection is key for economic development. The specifications in columns (3) and (4) therefore include an interaction between the degree of property rights protection and industry human capital intensity ($PROP_c * HCINT_s$). When we proxy human capital with years of schooling in column (3), both the property rights and the human capital level interaction with industry human capital intensity are insignificant.[32] But when human capital levels are proxied with schooling quality in column (4), the human capital level effect is significant at the 1% level,

[32] Average years of schooling is the country-level variable most strongly correlated with property rights protection in our dataset. This is not surprising as good property rights protection increases the incentives for (human) capital accumulation (Hall and Jones, 1999; Acemoglu, Johnson, and Robinson, 2001) and high human capital levels lead to institutional improvements (Glaeser et al., 2004). Note that both property rights protection and human capital levels are significant when interacted with industry intangible asset intensity and human capital intensity respectively (Table V, column (2)). This is an example of how focusing on possible theoretical channels can help in advancing our understanding of the growth effects of highly correlated country characteristics (Rajan and Zingales, 1998).

while $PROP_c * HCINT_s$ remains insignificant. The human capital accumulation effect remains statistically significant at the 1% level in both cases.

In columns (5) and (6), we include an interaction between GDP per worker and industry human capital intensity ($Y_c * HCINT_s$) in our regressions. As human capital is a major determinant of aggregate productivity, GDP per worker could actually be a better proxy for human capital than our indicators of schooling (both because human capital is broader than formal schooling and because formal schooling is observed with error).[33] Hence, the interaction between industry human capital intensity and aggregate productivity could capture the human capital level effect instead of the effect of high levels of development due to factors other than human capital. In column (5), $Y_c * HCINT_s$ enters positively and significantly, while the coefficient on the interaction between years of schooling and industry human capital intensity drops markedly relative to the same specification without $Y_c * HCINT_s$ (in column (5) of Table VI) and becomes insignificant. The interaction between industry human capital intensity and aggregate productivity also enters positively and significantly when we proxy the level of human capital with schooling quality in column (6). In this case, the human capital level effect only decreases by a third relative to the same specification without $Y_c * HCINT_s$ (see column (6) of Table VI). As the estimate also becomes somewhat less precise, the effect turns just insignificant. The human capital accumulation effect continues to be statistically significant at the 1% level.

In addition to being highly statistically significant, the human capital accumulation effect is also stable across specifications and similar to that reported earlier. This effect could, however, partly be capturing that countries experiencing fast aggregate growth demand more human-capital-intensive goods. It could also be capturing that rapid productivity growth always leads to shifts towards human-capital-intensive industries because rapidly growing countries are "modernizers". In columns (7) and (8), we therefore add an interaction between aggregate productivity growth and industry human capital intensity ($GROWTH_c * HCINT_s$) to our regressions. The effect of education improvements on growth in schooling-intensive industries remains positive and significant at the 1% level.

The specifications in Panel B use employment growth to capture changes in the pattern

[33] Human capital comprises education (quantity and quality) in and out of the classroom, on-the-job-learning and training, and health (Kartini Shastry and Weil, 2003). Manuelli and Seshadri (2005) show in a calibrated model that aggregate productivity is very closely related to properly measured aggregate human capital.

of specialization but are otherwise analogous to Panel A. The employment growth regressions continue to display a better fit (with an adjusted R^2 around 44%) than the output growth regressions (with an adjusted R^2 around 26%, see Panel A). In columns (1) and (2), we include the interaction between the physical capital-output ratio and industry human capital intensity in our regressions. Both $K_c/Y_c * HCINT_s$ and the human capital level interaction with industry human capital intensity enter positively and are significant at the 5% level. This is the case whether human capital levels are proxied with average years of schooling or schooling quality. The specifications in columns (3) and (4) include the interaction between the degree of property rights protection and industry human capital intensity. $PROP_c * HCINT_s$ enters insignificantly, while the interaction between human capital levels and industry human capital intensity is positive and significant at the 1% level, independently of the proxy for human capital levels used. The effect of high human capital levels on growth in human-capital-intensive industries is significant at the 5% level in columns (5) and (6), where we include an interaction between output per worker and industry human capital intensity in our employment regressions. $Y_c * HCINT_s$ is positive but just insignificant when we use schooling quality to proxy for human capital levels and positive and significant at the 5% level when we use the years-of-schooling proxy.

The specifications in columns (1)-(6) also confirm that human capital accumulation is a highly significant determinant of employment growth in human-capital-intensive industries. The interaction between education improvements and industry schooling intensity is always significant at the 1% level. Moreover, as shown in columns (7) and (8), the effect of education improvements on growth in schooling-intensive industries continues to be robust to the inclusion of an interaction between aggregate productivity growth and industry schooling intensity.

7 Conclusion

One way to progress in our understanding of the effects of human capital on growth is to examine channels through which such effects could work. If high levels of human capital facilitate technology adoption, better-educated countries should have adopted more rapidly the skilled-labor augmenting technologies becoming available since the 1970's. These countries should therefore have experienced faster output growth in more compared to less schooling-intensive industries in the 1980's. Theories of international specialization point to human capital accumulation as another important determinant of growth in human-capital-intensive industries. We therefore use data for 37 manufacturing industries in around 40 countries to examine whether higher levels of education and greater improvements in education were associated with faster growth in schooling-intensive industries in the 1980's.

We find that output growth in schooling-intensive industries was significantly faster in economies with higher education levels and greater education improvements. These results are robust to controlling for the growth effects of well-functioning financial markets and good property rights protection in external-finance-dependent and intangible-asset-intensive industries respectively (Rajan and Zingales, 1998; Claessens and Laeven, 2003). They are also robust to controlling for additional effects of domestic capital markets on industry growth (Fisman and Love, 2003, 2004). The magnitude of the differential industry growth effects of education levels and improvements is similar or larger than the differential growth effects of financial development and property rights protection. Furthermore, when we examine the differential industry growth effects of human capital using employment data, we find even stronger evidence for positive effects of education levels and improvements on growth in schooling-intensive industries.

A Appendix

A.1 Country Sample

Australia, Austria, Bangladesh, Belgium, Brazil, Canada, Chile, Colombia, Costa Rica, Denmark, Egypt, Finland, France, Germany, Greece, India, Indonesia, Israel, Italy, Jamaica, Japan, Jordan, Kenya, South Korea, Malaysia, Mexico, Morocco, Netherlands, New Zealand, Nigeria, Norway, Pakistan, Peru, Philippines, Portugal, Singapore, South Africa, Spain, Sri Lanka, Sweden, Turkey, United Kingdom, Venezuela, Zimbabwe.

A.2 Variable Definitions and Sources

Country-Industry Specific

- $GROWTH_{s,c}$: Annual growth rate of real value added in industry s in country c over the 1980-1989 period. No data is available for Indonesia and Jamaica. Source: Rajan and Zingales (1998). Original source: United Nations Industrial Development Organization (UNIDO) Industrial Statistics, 1993.
- $FRACT_{s,c}$: Share of industry s in total value added in manufacturing in country c in 1980. Source: Rajan and Zingales (1998). Original source: UNIDO Industrial Statistics.
- $EMPGR_{s,c}$: Annual growth rate of employment in industry s in country c over the 1981-1990 period. No data is available for Costa Rica, Jamaica, and Nigeria. Source: UNIDO Industrial Statistics. Not all International Standard Industrial Classification sectors for which the UNIDO Industrial Statistics report data are mutually exclusive. RZ therefore calculate the values of broader sectors net of the values of subsectors that are separately reported by the Industrial Statistics. We follow their approach for the employment data.

Industry-Specific

- $HCINT$: Average years of schooling at the industry level. This variable is based on data from the 1980 Integrated Public Use Microdata Series. We extract two series: $i)$ hours worked by industry and years of education; ii) number of employees by industry and education. Our calculations are based on eight groups of educational attainment: i) 0 years of schooling; ii) 1-4 years of schooling; iii) 5-8 years of schooling; iv) 9-11 years of schooling; v) 12 years of schooling; vi) 13-15 years of schooling; vii) 16 years of schooling; $viii$) more than 16 years of schooling. Average years of schooling in each industry is obtained by multiplying the share of employees in each educational attainment group by 0, 1, 6, 10, 12, 14, 16 and 18 respectively. We also calculate two additional industry-level human capital intensity indicators. The ratio of hours worked by employees with at least 12 years of schooling to total hours worked by all employees in each industry, $HCINT(SEC)$. And the ratio of hours worked by employees with at least 16 years of education to total hours worked in each industry, $HCINT(COLL)$. We calculate the values of broader sectors net of the values of subsectors that are separately reported by the Industrial Statistics (for details on why this is necessary see the explanation under $EMPGR$). Source: Integrated Public Use Microdata Series.

- $EXTFIN$: 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: Rajan and Zingales (1998). Original source: COMPUSTAT.

- $OPPORT$: Industry growth opportunities. Defined as the industry-level median growth rate of sales for U.S. firms averaged over the 1980-1989 period. Source: Fisman and Love (2004). Original source: COMPUSTAT.

- $TRADEINT$: Industry dependence on trade credit. Defined as the industry-median of the ratio of accounts payable to total assets for U.S. firms averaged over the 1980-1989 period. Source: Fisman and Love (2003). Original source: COMPUSTAT.

- $INTANG$: Industry dependence on intangible assets. Defined as the industry-median of the ratio of intangible assets to net fixed assets for U.S. firms averaged over the 1980-1989 period. Source: Claessens and Laeven (2003). Original source: COMPUSTAT.

- $INVINT$: Industry (physical capital) investment intensity. Defined as the ratio of capital expenditure to property plant and equipment for U.S. firms averaged over the 1980-1989 period. Source: Rajan and Zingales (1998). Original source: COMPUSTAT. We also use three additional measures of industry physical capital intensity. One minus the share of wages in value added, capital stock over value added, and capital stock over employment, all for U.S. industries before 1980. Source: NBER-CES Manufacturing Industry Database (Bartelsman and Gray, 1996).

- $NONPROD$: Defined as the ratio of non-production workers to total employment in U.S. manufacturing industries in 1980. Source: NBER-CES Manufacturing Industry Database (Bartelsman and Gray, 1996).

Country-Specific:

- $PRIV$: Private credit to GDP in 1980. Private credit is defined as private domestic credit held by monetary authorities and depositary institutions (excluding interbank deposit). No data is available for Nigeria. Source: Fisman and Love (2003). Original source: IMF International Financial Statistics.

- $PROP$: Index of property rights protection on a scale from 1 to 5; higher values indicate higher protection. The index refers to the 1995-1999 period. Source: Claessens and Laeven (2003). Original source: The Index of Economic Freedom (The Heritage Foundation).

- K/Y : Log physical capital-GDP ratio in 1980. The physical capital stock is calculated using the perpetual inventory method as implemented by Hall and Jones (1999) and Caselli (2005). Source: Penn World Table, 5.6 (downloadable from: http://pwt.econ.upenn.edu).

- SCH^{BL} : Average years of schooling of the population aged 25 and over. No data is available for Nigeria and Morocco. There is also no data for Egypt before 1980. Source: Barro and Lee (2001).

- SCH^{CS} : Average years of schooling of the population aged 25 and over. No data is available for Sri Lanka, Israel, and Pakistan. Source: Cohen and Soto (2001).

- Y : Log of real GDP per worker. Source: Penn World Table 5.6.

- $GROWTH$: Logarithmic growth rate of real GDP per worker. Source: Penn World Table 5.6.

- $LFQUAL$: Labor force quality measure on a 0-100 scale. The index is based on results in mathematics and science tests administrated by the International Association for the Evaluation of Educational Achievement and International Assessment of Educational Progress between 1965 and 1991. Test results were originally collected and processed to ensure international and intertemporal comparability by Hanushek and Kimko (2000). Hanushek and Kimko use this data to obtain a measure of labor-force quality for 39 countries. They expand the country coverage of their measure by estimating a model of labor-force quality determination. This model is based on 31 countries due to data unavailability for some explanatory variables. Bosworth and Collins (2003) follow the Hanushek and Kimko approach but use updated and additional primary data. Source: Bosworth and Collins (2003).

- TAR^{SW} : Average import-weighted tariff rate over the 1980's on intermediates and capital goods. Source: Sachs and Warner (1995). Original source: UNCTAD.
- TAR^{WB} : Average unweighted tariff rate over the 1980's for all goods. Source: World Bank. (http://siteresources.worldbank.org/INTRANETTRADE/Resources/tar2002.xls)

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Figure 1: Estimated Industry-Specific Coefficient on Schooling Years and Human Capital Intensity in the U.S.

Figure 1a

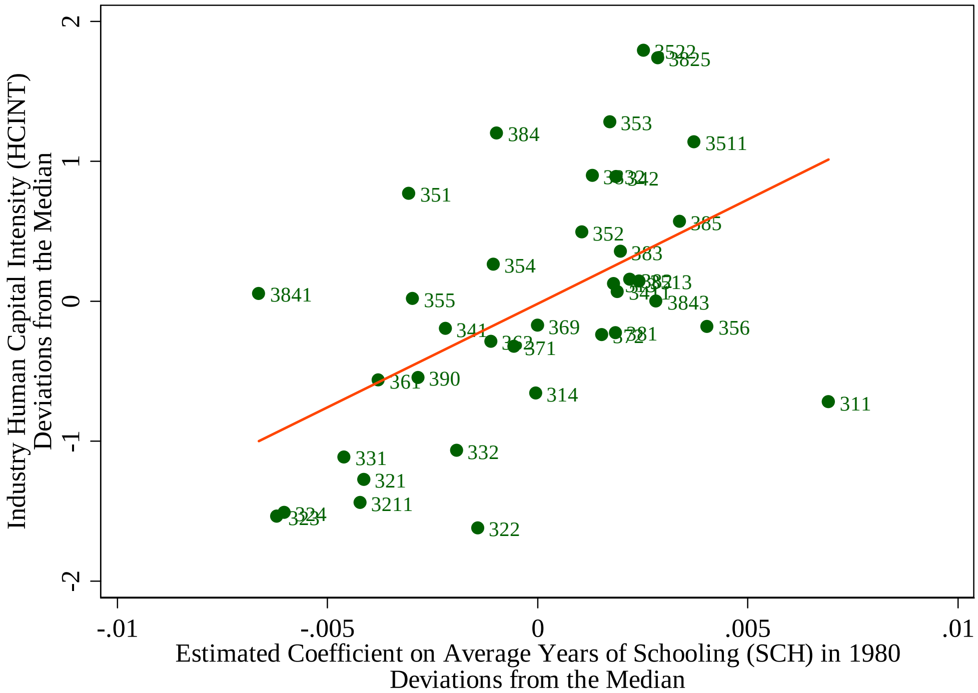
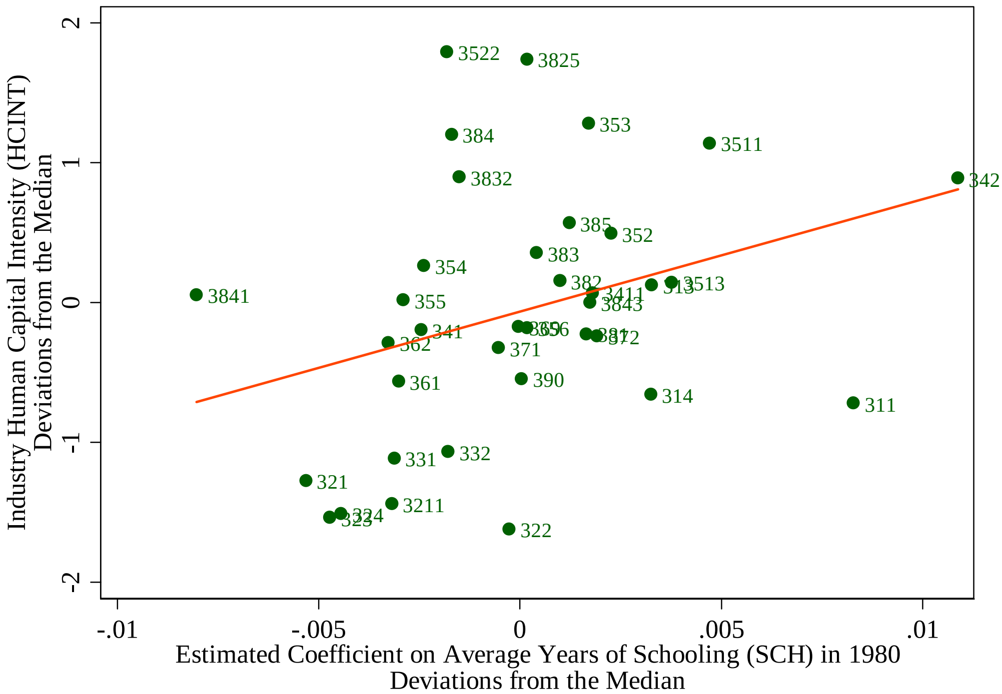


Figure 1b

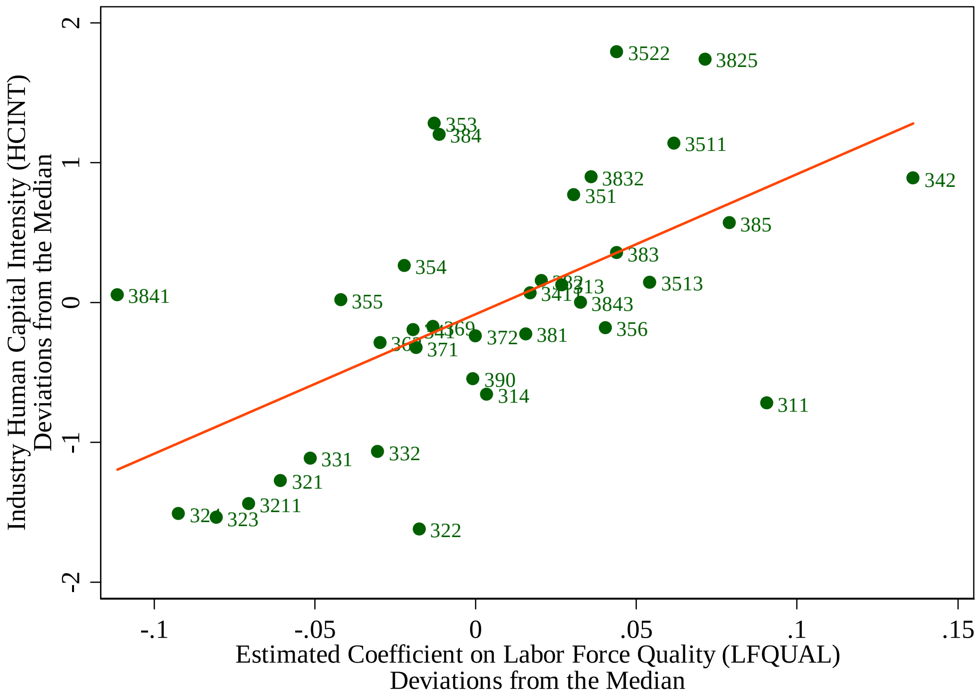


Figures 1a and 1b plot estimates of the marginal effect of years of schooling in 1980 on 1980-1989 industry output growth (δ_s; on the horizontal axis) against industry human capital intensity ($HCINT_s$; on the vertical axis). Both $HCINT_s$ and δ_s are in deviations from their median. The numbers refer to ISIC codes (see Table I). The two figures differ in that the estimates in Figure 1b account for the role of financial development and property rights protection for growth in finance-dependent and intangible-assets-intensive industries respectively.

Figure 2: Estimated Industry-Specific Coefficient on Schooling Quality and Human Capital Intensity in the U.S.

Figure 2a

Figure 2b



Figures 2a and 2b plot estimates of the marginal effect of labor-force quality on 1980-1989 industry output growth (on the horizontal axis) against industry human capital intensity ($HCINT_S$; on the vertical axis). Both $HCINT_S$ and industry-specific marginal effects are in deviations from their median. The numbers refer to ISIC codes (see Table I). The two figures differ in that the estimates in Figure 2b account for the role of financial development and property rights protection for growth in finance-dependent and intangible-assets-intensive industries respectively.

Figure 3: Estimated Industry-Specific Coefficient on Changes in Schooling and Human Capital Intensity in the U.S.

Figure 3a

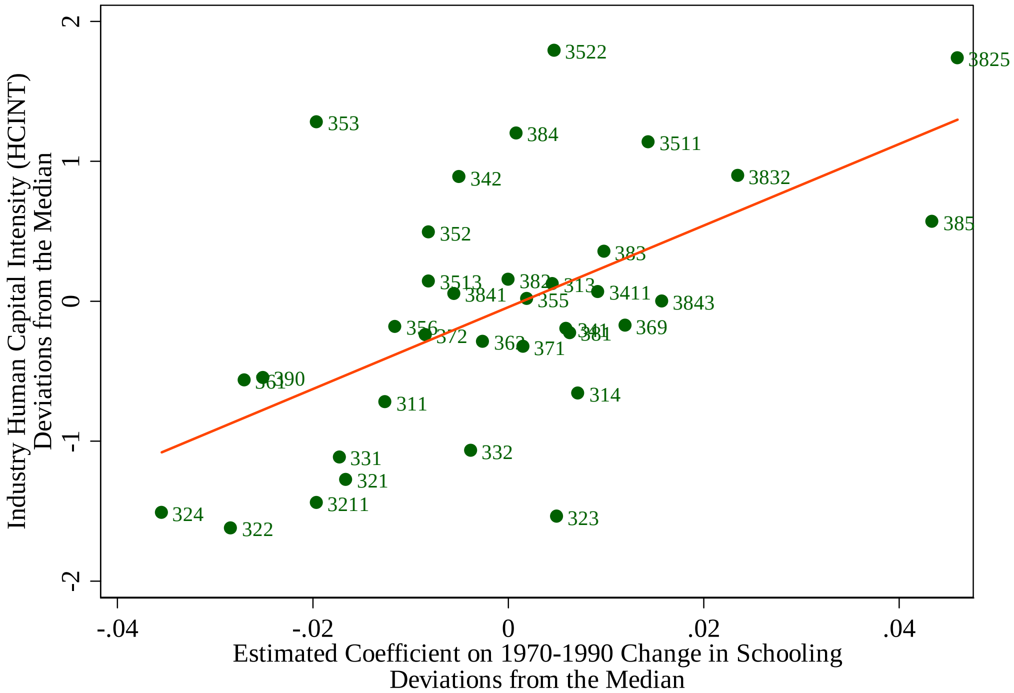
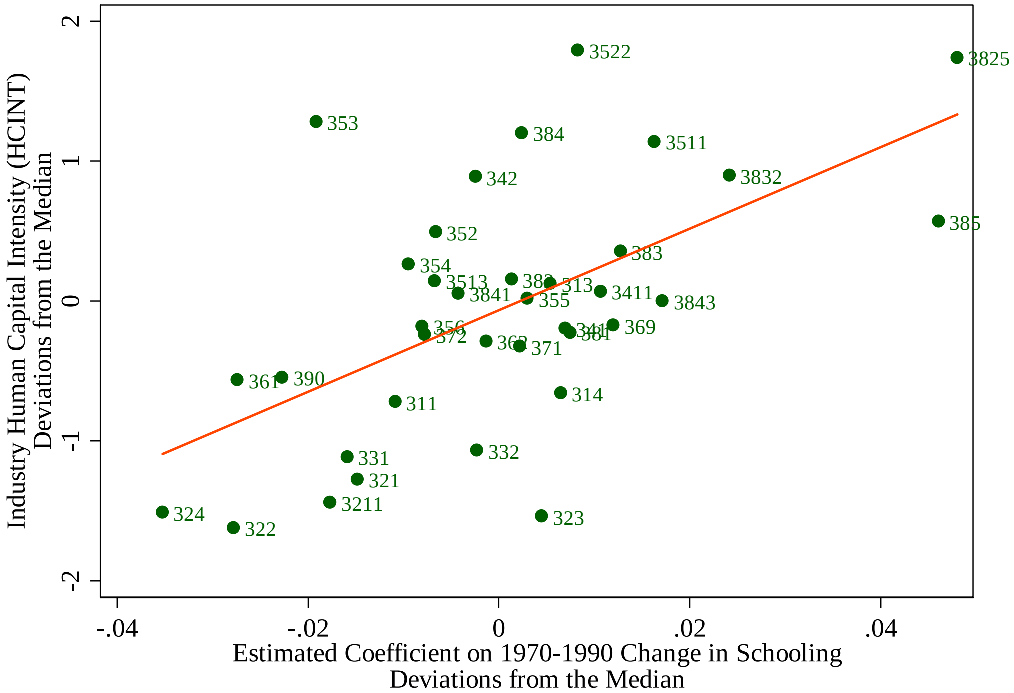


Figure 3b



Figures 3a and 3b plot estimates of the marginal effect of 1970-1990 improvements in schooling on 1980-1989 industry output growth (θ_s; on the horizontal axis) against industry human capital intensity ($HCINT_s$; on the vertical axis). Both $HCINT_s$ and θ_s are in deviations from their median. The numbers refer to ISIC codes (see Table I). The two figures differ in that the estimates in Figure 3b account for the role of financial development and property rights protection for growth in finance-dependent and intangible-assets-intensive industries respectively.

Table I -- Industry Measures of Human Capital Intensity (Dependence)

ISIC Code	Industry Name	*HCINT*	*HCINT(SEC)*	*HCINT(COLL)*
3522	Drugs	13.45	87.22%	35.14%
3825	Office, computing	13.40	90.01%	29.29%
353	Petroleum refineries	12.94	87.26%	25.05%
384	Transportation equipment	12.86	84.20%	23.42%
3511	Basic chemicals excl. fertilizers	12.79	84.06%	24.54%
3832	Radio	12.55	83.29%	18.79%
342	Printing and Publishing	12.54	83.89%	19.97%
351	Industrial chemicals	12.42	81.60%	20.03%
385	Professional goods	12.22	79.31%	18.50%
352	Chemicals	12.15	77.08%	18.96%
383	Electric machinery	12.01	76.08%	15.29%
354	Petroleum and coal products	11.92	69.06%	14.08%
382	Machinery	11.81	76.23%	10.23%
3513	Synthetic resins	11.80	75.21%	15.14%
313	Beverages	11.78	73.81%	13.09%
3411	Pulp, paper	11.72	75.23%	10.68%
3841	Ship building and repairing	11.71	74.78%	9.99%
355	Rubber products	11.67	74.39%	10.26%
3843	Motor vehicle	11.65	73.46%	10.95%
369	Non-metal products	11.48	67.80%	14.20%
356	Plastic products	11.48	71.50%	10.19%
341	Paper and Products	11.46	70.51%	11.05%
381	Metal products	11.43	69.87%	9.71%
372	Non-ferrous metals	11.42	70.31%	9.66%
362	Glass	11.37	69.13%	8.68%
371	Iron & Steel	11.33	69.61%	8.32%
390	Other ind.	11.11	65.12%	11.92%
361	Pottery	11.09	65.01%	9.87%
314	Tobacco	11.00	66.04%	10.99%
311	Food products	10.93	65.55%	9.74%
332	Furniture	10.59	58.31%	7.09%
331	Wood Products	10.54	59.29%	7.06%
321	Textile	10.38	53.83%	6.94%
3211	Spinning	10.21	49.76%	5.49%
324	Footwear	10.14	52.07%	3.69%
323	Leather	10.12	50.69%	7.06%
322	Apparel	10.04	51.09%	5.07%
	Mean	11.61	71.13%	13.52%
	Standard Deviation	0.90	10.87%	7.12%
	Median	11.65	71.50%	10.95%
	0.25 Percentile	11.09	65.55%	9.66%
	0.75 Percentile	12.15	77.08%	18.50%

Table I reports average years of schooling of employees (HCINT) for all industries in our sample calculated using U.S. data. We also report two additional measures of industry-level human capital intensity (HCINT(SEC) and HCINT(COLL)). HCINT(SEC) is the ratio of hours worked by employees with at least 12 years of schooling (necessary for completing secondary school) to total hours worked. HCINT(COLL) is the ratio of hours worked by employees with at least 16 years of schooling (college) to total hours worked. The bottom rows give some descriptive statistics. The data comes from the Integrated Public Use Microdata Series and corresponds to 1980. ISIC stands for International Standard Industrial Classification. See the Appendix for details on the construction of the three human capital intensity measures.

Table II--Correlation Structure

Panel A - Industry-level Variables

HCINT	1								
HCINT(SEC)	0.9780*	1							
HCINT(COLL)	0.9239*	0.8502*	1						
NONPROD	0.8665*	0.8193*	0.8660*	1					
EXTFIN	0.5614*	0.5200*	0.5431*	0.4885*	1				
INTANG	0.2253	0.2421	0.281	0.3741	0.1443	1			
INVINT	0.5721*	0.5654*	0.5645*	0.5808*	0.8116*	0.4038	1		
TRADEINT	-0.2018	-0.2135	-0.233	-0.2149	-0.1149	-0.1553	-0.1047	1	
OPPORT	0.3475	0.3397	0.3684	0.4213	0.6498*	0.3557	0.7666*	-0.1927	1

Panel B - Country-level Variables

SCH80(BL)	1								
SCH70(BL)	0.9698*	1							
Δ(SCH(BL)9070)	-0.015	-0.1761	1						
Δ(SCH(BL)9080)	-0.2837	-0.2424	0.6824*	1					
LFQUAL	0.6622*	0.6651*	0.1073	0.0825	1				
PRIV	0.4188*	0.4071*	0.1239	0.0987	0.5884*	1			
K/Y	0.7284*	0.7650*	0.0661	0.1389	0.7016*	0.5753*	1		
PROP	0.6123*	0.6241*	-0.054	-0.1168	0.5678*	0.3783	0.5879*	1	
Y	0.7703*	0.7881*	-0.1304	-0.1936	0.5091*	0.4251*	0.6088*	0.6342*	1

Panel A reports correlations between the main industry-level variables. The correlations are based on either 36 or 37 industry observations, depending on the variables considered. Panel B reports correlations between the main country-level variables. These correlations are based on 39 to 43 country observations, depending on the variables considered. The Data Appendix gives detailed variable definitions and sources. * denotes that the correlation is significant at the 1% confidence level.

Table III--Human Capital Level (Quantity & Quality) and Industry Growth

	Average Years of Schooling (*SCH*)				Labor Force Quality (*LFQUAL*)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FRACTs,c	-0.8817	-0.9402	-0.9052	-0.9631	-1.0199	-0.9757	-0.9367	-0.9994
	(3.48)	*(3.73)*	*(3.55)*	*(3.80)*	*(3.95)*	*(3.75)*	*(3.56)*	*(3.80)*
Human Capital Quantity Interaction	*0.0034*	0.0024	0.0030	0.0021			-0.0008	-0.0015
[*SCH80 X HCINT*]	*(2.55)*	*(1.87)*	*(2.24)*	*(1.56)*			*(0.56)*	*(1.09)*
Human Capital Quality Interaction					0.0869	0.0715	0.0931	0.0865
[*LFQUAL X HCINT*]					*(3.50)*	*(2.82)*	*(3.13)*	*(2.96)*
Finance Interaction		0.1015		0.1004		0.0734		0.0753
[*PRIV X EXTFIN*]		*(2.77)*		*(2.76)*		*(2.15)*		*(2.18)*
Property Rights Interaction			0.0069	0.0068		0.0057		0.0060
[*PROP X INTANG*]			*(2.48)*	*(2.47)*		*(2.07)*		*(2.11)*
Adjusted R2	0.222	0.245	0.224	0.247	0.216	0.257	0.233	0.257
Obs	1240	1207	1240	1207	1277	1217	1240	1217
Countries	40	40	40	40	42	41	40	41
Industry-Country Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Differential in Real Growth (75%-25%)	0.0177	0.0128	0.0156	0.0109	0.0220	0.0181	0.0236	0.0219

The dependent variable is the annual real growth rate of value added at the industry-country level for the period 1980-1989 (GROWTHs,c). FRACTs,c indicates the industry share in total value added in manufacturing in 1980. The human capital quantity (years of schooling) interaction is the product of industry-level human capital intensity (HCINT) and country-level average years of schooling in 1980 (SCH80). The human capital quality (schooling quality) interaction is the product of HCINT and an indicator of the country-level quality of the labor force (LFQUAL). The finance interaction is the product of industry-level dependence on external finance (EXTFIN) and country-level financial development in 1980 (PRIV). The property rights interaction is the product of industry dependence on intangible assets (INTANG) and a country-level measure of property rights protection (PROP).

The last row reports on the magnitude of the human capital level effect. We calculate how much faster an industry at the 75th percentile of human capital intensity is predicted to grow relative to an industry at the 25th percentile, when comparing a country with a level of human capital at the 75th percentile to a country at the 25th percentile. The Data Appendix gives more detailed variable definitions and the sources of the data. All specifications include country and industry fixed effects. Absolute values of t-statistics based on robust standard errors are reported in parenthesis and italics below the coefficients.

Table IV--Human Capital Accumulation and Industry Growth

	(1)	(2)	(3)	(4)	(5)	(6)
FRACTs,c	-0.8274	-0.9017	*-0.8603*	-0.9303	-0.9090	-0.9350
	(3.18)	*(3.46)*	*(3.27)*	*(3.53)*	*(3.46)*	*(3.56)*
Human Capital Accumulation Interaction	*0.0087*	0.0108	*0.0086*	0.0108	0.0103	0.0107
[*Δ(SCH9070) X HCINT*]	*(2.37)*	*(3.44)*	*(2.36)*	*(3.44)*	*(3.26)*	*(3.30)*
Finance Interaction		0.1081		0.1042		0.0965
[*PRIV X EXTFIN*]		*(2.87)*		*(2.82)*		*(2.05)*
Property Rights Interaction			0.0084	0.0078		0.0074
[*PROP X INTANG*]			*(2.92)*	*(2.81)*		*(2.45)*
Investment Interaction					0.0001	0.0000
[*ΔK/L9070 X INVINT*]					*(3.11)*	*(0.37)*
Adjusted R2	0.263	0.241	0.267	0.245	0.238	0.244
Obs	1203	1171	1203	1171	1171	1171
Countries	39	39	39	39	39	39
Industry-Country Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Differential in Real Growth (75%-25%)	0.0090	0.0112	0.0089	0.0112	0.0107	0.0111

The dependent variable is the annual real growth rate of value added at the industry-country level for the period 1980-1989 (GROWTHs,c). FRACTs,c indicates the industry share in total value added in manufacturing in 1980. The human capital accumulation interaction is the product of industry-level human capital intensity (HCINT) and the country-level change in average years of schooling over the 1970-1990 period (ΔSCH). The finance interaction is the product of industry-level dependence on external finance (EXTFIN) and country-level financial development in 1980 (PRIV). The property rights interaction is the product of industry dependence on intangible assets (INTANG) and a country-level measure of property rights protection (PROP).

The investment interaction is the product of the country-level change in capital per worker over the 1970-1990 period (ΔK/L) and the Rajan and Zingales (1998) industry-level investment intensity (INVINT). The last row reports on the magnitude of the human capital accumulation effect. We calculate how much faster an industry at the 75th percentile of human capital intensity is predicted to grow relative to an industry at the 25th percentile, when comparing a country with a rate of human capital accumulation over the 1970-1990 period at the 75th percentile to a country at the 25th percentile. The Data Appendix gives more detailed variable definitions and the sources of the data. All specifications include country and industry fixed effects. Absolute values of t-statistics based on robust standard errors are reported in parenthesis and italics below the coefficients.

Table V--Capital Accumulation, Human Capital Level and Industry Growth

	Schooling Years (*SCH*)		Labor Force Quality (LFQUAL)		Both *SCH* & *LFQUA* L		Physical Capital	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FRACTs,c	-0.8657	-0.9424	-0.9076	-0.9681	-0.9075	-0.9689	-0.9356	-0.9578
	(3.23)	*(3.50)*	*(3.31)*	*(3.52)*	*(3.30)*	*(3.52)*	*(3.46)*	*(3.47)*
Human Capital Accumulation Interaction	0.0107	*0.0123*	0.0067	0.0093	0.0068	0.0089	0.0117	0.0087
[*Δ(SCH9070) X HCINT*]	*(2.77)*	*(3.71)*	*(1.88)*	*(3.03)*	*(1.84)*	*(2.83)*	*(3.48)*	*(2.90)*
Human Capital Quantity Interaction	0.0038	0.0026			0.0001	-0.0004	0.0032	
[*SCH70 X HCINT*]	*(2.59)*	*(1.78)*			*(0.08)*	*(0.32)*	*(2.01)*	
Human Capital Quality Interaction			0.0770	0.0621	0.0759	0.0668		0.0675
[*LFQUAL X HCINT*]			*(2.99)*	*(2.35)*	*(2.54)*	*(2.26)*		*(2.32)*
Finance Interaction		0.0887		0.0707		0.0709	0.0864	0.0798
[*PRIV X EXTFIN*]		*(2.47)*		*(2.02)*		*(2.02)*	*(1.90)*	*(1.83)*
Property Rights Interaction		0.0065		0.0061		0.0061	0.0070	0.0070
[*PROP X INTANG*]		*(2.25)*		*(2.07)*		*(2.07)*	*(2.28)*	*(2.26)*
Investment Interaction							0.0109	-0.0040
[*ΔK/L9070) X INVINT*]							*(0.48)*	*(0.16)*
Physical Capital Level Interaction							-0.0211	-0.0154
[*K/L70 X INVINT*]							*(1.51)*	*(1.17)*
Adjusted R2	0.220	0.248	0.271	0.253	0.226	0.253	0.248	0.253
Obs	1203	1171	1203	1171	1203	1171	1171	1171
Countries	39	39	39	39	39	39	39	39
Industry-Country Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The dependent variable is the annual real growth rate of value added at the industry-country level for the period 1980-1989 (GROWTHs,c). FRACTs,c indicates the industry share in total value added in manufacturing in 1980. The human capital accumulation interaction is the product of industry-level human capital intensity (HCINT) and the country-level change in average years of schooling over the 1970-1990 period (ΔSCH). The human capital quantity (years of schooling) interaction is the product of industry-level human capital intensity (HCINT) and country-level average years of schooling in 1970 (SCH70). The human capital quality (schooling quality) interaction is the product of HCINT and an indicator of the country-level quality of the labor force (LFQUAL).
The finance interaction is the product of industry-level dependence on external finance (EXTFIN) and country-level financial development in 1980 (PRIV). The property rights interaction is the product of industry dependence on intangible assets (INTANG) and a country-level measure of property rights protection (PROP).
The investment interaction is the product of industry-level investment intensity (INVINT) and the country-level change in capital per worker over the 1970-1990 period (ΔK/L). The physical capital level interaction is the product of INVINT and capital per worker in 1970 (K/L). The Data Appendix gives more detailed variable definitions and the sources of the data. All specifications include country and industry fixed effects. Absolute values of t-statistics based on robust standard errors are reported in parenthesis and italics below the coefficients.

Table VI - Financial Development, Human Capital and Industry Growth

	(1)	(2)	(3)	(4)	(5)	(6)
FRACTs,c	-0.9469	-0.9743	-0.9448	-0.9713	-0.9332	-0.9676
	(3.52)	*(3.53)*	*(3.52)*	*(3.54)*	*(3.47)*	*(3.52)*
Human Capital Accumulation Interaction	0.0126	0.0094	0.0124	0.0094	0.0129	0.0094
[*Δ(SCH9070)* X *HCINT*]	*(3.81)*	*(3.06)*	*(3.78)*	*(3.06)*	*(3.84)*	*(3.08)*
Human Capital Quantity Interaction	0.0028		0.0027		0.0031	
[*SCH70* X *HCINT(SCH)*]	*(1.93)*		*(1.87)*		*(2.09)*	
Human Capital Quality Interaction		0.0660		0.0641		0.0698
[*LFQUAL* X *HCINT(SCH)*]		*(2.53)*		*(2.45)*		*(2.66)*
Finance Interaction	0.0819	0.0626	0.0344	0.0139		
[*PRIV X EXTFIN*]	*(2.34)*	*(1.84)*	*(0.81)*	*(0.34)*		
Property Rights Interaction	0.0058	0.0053	0.0051	0.0046	0.0047	0.0043
[*PROP X INTANG*]	*(2.02)*	*(1.82)*	*(1.90)*	*(1.69)*	*(1.73)*	*(1.58)*
Finance-Trade Credit Interaction	-0.8580	-0.9060			-0.5672	-0.6580
[*PRIV* X *TRADEINT*]	*(2.85)*	*(2.91)*			*(1.82)*	*(2.05)*
Finance-Growth Opportunities Interaction			1.1524	1.1968	1.1560	0.9699
[*PRIV* X *OPPORT*]			*(1.71)*	*(1.77)*	*(1.98)*	*(1.66)*
Adjusted R2	0.252	0.258	0.251	0.256	0.252	0.259
Obs	1171	1171	1171	1171	1171	1171
Countries	39	39	39	39	39	39
Industry-Country Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes

The dependent variable is the annual real growth rate of value added at the industry-country level for the period 1980-1989 (GROWTHs,c). FRACTs,c indicates the industry share in total value added in manufacturing in 1980. The human capital accumulation interaction is the product of industry-level human capital intensity (HCINT) and the country-level change in average years of schooling over the 1970-1990 period (ΔSCH). The human capital quantity (years of schooling) interaction is the product of industry-level human capital intensity (HCINT) and country-level average years of schooling in 1970 (SCH70). The human capital quality (schooling quality) interaction is the product of HCINT and an indicator of the country-level quality of the labor force (LFQUAL). The finance interaction is the product of industry-level dependence on external finance (EXTFIN) and country-level financial development in 1980 (PRIV).

The property rights interaction is the product of industry dependence on intangible assets (INTANG) and a country-level measure of property rights protection (PROP). The finance trade credit interaction is the product of an industry-level measure of trade credit dependence (TRADEINT) and the country-level financial development (PRIV) in 1980. The finance growth opportunities interaction is the product of an industry-level measure of global industry growth opportunities (OPPORT) and country-level financial development in 1980. The Data Appendix gives more detailed variable definitions and the sources of the data. All specifications include country and industry fixed effects. Absolute values of t-statistics based on robust standard errors are reported in parenthesis and italics below the coefficients.

Table VII : Human Capital Accumulation, Human Capital Level and Employment Growth

	Average Schooling Years (*SCH*)				Labor Force Quality (*LBQUAL*)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FRACTs,c	-0.1222	-0.1437	-0.1433	-0.1404	-0.1472	-0.1659	-0.1659	-0.1643
	(1.16)	*(1.36)*	*(1.36)*	*(1.33)*	*(1.35)*	*(1.52)*	*(1.52)*	*(1.51)*
Human Capital Accumulation Interaction	0.0083	0.0087	0.0087	0.0088	0.0045	0.0050	0.0050	0.0050
[*Δ(SCH9070)* X *HCINT*]	*(4.61)*	*(4.81)*	*(4.79)*	*(4.81)*	*(2.71)*	*(2.99)*	*(2.98)*	*(3.00)*
Human Capital Quantity Interaction	0.0041	0.0040	0.0040	0.0041				
[*SCH70* X *HCINT(SCH)*]	*(5.15)*	*(4.85)*	*(4.78)*	*(4.80)*				
Human Capital Quality Interaction					0.0680	0.0666	0.0666	0.0671
[*LFQUAL* X *HCINT(SCH)*]					*(4.29)*	*(4.02)*	*(3.93)*	*(3.96)*
Finance Interaction		0.0217	0.0218			0.0161	0.0161	
[*PRIV X EXTFIN*]		*(1.57)*	*(1.58)*			*(1.21)*	*(1.21)*	
Property Rights Interaction		0.0005	0.0006	0.0003		0.0008	0.0008	0.0006
[*PROP X INTANG*]		*(0.41)*	*(0.46)*	*(0.22)*		*(0.62)*	*(0.61)*	*(0.43)*
Finance-Trade Credit Interaction			0.0821	0.1847			0.0001	0.0806
[*PRIV* X *TRADEINT*]			*(0.54)*	*(1.17)*			*(0.00)*	*(0.48)*
Finance-Growth Opportunities Interaction				0.3308				0.2614
[*PRIV* X *OPPORT*]				*(1.64)*				*(1.29)*
Adjusted R2	0.428	0.437	0.437	0.437	0.431	0.440	0.439	0.439
Obs	1124	1094	1094	1094	1124	1094	1094	1094
Countries	39	39	39	39	39	39	39	39
Industry-Country Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The dependent variable is the annual growth rate of employment at the industry-country level for the period 1981-1990 (EMPGRs,c). FRACTs,c indicates the industry share in total value added in manufacturing in 1980. The human capital accumulation interaction is the product of industry-level human capital intensity (HCINT) and the country-level change in average years of schooling over the 1970-1990 period (ΔSCH). The human capital quantity (years of schooling) interaction is the product of industry-level human capital intensity (HCINT) and country-level average years of schooling in 1970 (SCH70). The human capital quality (schooling quality) interaction is the product of HCINT and an indicator of the country-level quality of the labor force (LFQUAL). The finance interaction is the product of industry-level dependence on external finance (EXTFIN) and country-level financial development in 1980 (PRIV).

The property rights interaction is the product of industry dependence on intangible assets (INTANG) and a country-level measure of property rights protection (PROP). The finance trade credit interaction is the product of an industry-level measure of trade credit dependence (TRADEINT) and the country-level financial development in 1980 (PRIV). The finance growth opportunities interaction is the product of an industry-level measure of global industry growth opportunities (OPPORT) and country-level financial development in 1980. The Data Appendix gives more detailed variable definitions and the sources of the data. All specifications include country and industry fixed effects. Absolute values of t-statistics based on robust standard errors are reported in parenth and italics below the coefficients.

Table VIII - Tariff Protection, Human Capital and Industry Growth

	Median tariff rate threshold				40% tariff rate threshold			
	World Bank		Sachs-Warner		World Bank		Sachs-Warner	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FRACTs,c	-0.9774	-0.9365	-0.9984	-0.9812	-0.9841	-0.9523	-1.0241	-0.9886
	(3.54)	*(3.51)*	*(3.50)*	*(3.57)*	*(3.37)*	*(3.36)*	*(3.43)*	*(3.42)*
HC Accumulation - HC Intensity in "Low Tariff"	0.0049	0.0114	0.0118	0.0149	0.0100	0.0122	0.0094	0.0121
[*Δ(SCH9070)* X *HCINT* X *LOW*]	*(2.05)*	*(3.29)*	*(3.03)*	*(3.97)*	*(3.32)*	*(3.88)*	*(2.55)*	*(3.35)*
HC Accumulation - HC Intensity in "High Tariff"	0.0125	0.0166	0.0029	0.0116	-0.0268	-0.0250	-0.0272	-0.0277
[*Δ(SCH9070)* X *HCINT X HIGH*]	*(1.72)*	*(2.39)*	*(0.32)*	*(1.76)*	*(1.06)*	*(0.89)*	*(0.81)*	*(0.88)*
HC Quality - HC Intensity in "Low Tariff"	0.0938		0.0563		0.0498		0.0689	
[*LFQUAL* X *HCINT* X *LOW*]	*(3.20)*		*(1.93)*		*(2.43)*		*(2.77)*	
HC Quality - HC Intensity in "High Tariff"	0.0848		0.0952		0.2518		0.4629	
[*LFQUAL* X *HCINT* X *HIGH*]	*(1.39)*		*(1.42)*		*(1.48)*		*(1.34)*	
HC Quantity - HC Intensity in "Low Tariff"		0.0032		0.0024		0.0021		0.0023
[*SCH70* X *HCINT* X *LOW*]		*(2.06)*		*(1.48)*		*(1.69)*		*(1.72)*
HC Quantity - HC Intensity in "High Tariff"		0.0000		0.0010		0.0181		0.0228
[*SCH70* X *HCINT* X *HIGH*]		*(0.01)*		*(0.26)*		*(0.89)*		*(1.19)*
Other Controls	Financial Development X Growth Opportunities [*PRIV* X *OPPORT*]; Financial Development X Trade Affinity *PRIV* X *TRADEINT*]; Property Rights Protection X Intangibility Intensity [*PROP* X *INTANG*]							
Adjusted R2	0.260	0.251	0.263	0.257	0.265	0.257	0.268	0.261
Obs	1171	1171	1078	1078	1171	1171	1078	1078
Countries	39	39	35	35	39	39	35	35
Industry-Country Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The dependent variable is the annual real growth rate of value added at the industry-country level for the period 1980-1989 (GROWTHs,c). FRACTs,c indicates the industry share in total value added in manufacturing in 1980. HIGH and LOW are indicator variables that equal one if a country has relatively high and relatively low tariff rates respectively and zero otherwise. In columns (1)-(4) we use the median value of tariffs in our sample as a threshold between HIGH and LOW. In columns (5)-(8) we use a 40% threshold. Tariff data is taken from the World Bank in columns (1), (2), (5), and (6). In columns (3), (4), (7) and (8) we use tariff data from Sachs and Warner (1995). The human capital accumulation interactions (for HIGH and LOW tariff countries) equal the product of industry-level human capital intensity (HCINT) and the country-level change in average years of schooling over the 1970-1990 period (ΔSCH).

The human capital quantity (years of schooling) interactions (for HIGH and LOW tariff countries) equal the product of industry-level human capital intensity (HCINT) and country-level average years of schooling in 1970 (SCH70). The human capital quality (schooling quality) interactions (for HIGH and LOW tariff countries) equal the product of HCINT and an indicator of the country-level quality of the labor force (LFQUAL). All specifications also include (coefficients not reported): A finance trade credit interaction, defined as the product of an industry-level measure of trade credit dependence (TRADEINT) and the country-level financial development in 1980 (PRIV); a finance growth opportunities interaction, defined as the product of an industry-level measure of global industry growth opportunities (OPPORT) and country-level financial development in 1980 (PRIV); and a property rights interaction, defined as the product of industry dependence on intangible assets (INTANG) and a country-level measure of property rights protection (PROP). The Data Appendix gives more detailed variable definitions and the sources of the data.

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

Table IX - Measurement Error and Logarithmic Specifications

	Change (1990-1980) in schooling and initial (1980) level of schooling measured as					
	Average Schooling Years			Logarithm of Average Schooling Years		
	Barro-Lee	*Cohen-Soto*	*IV Barro-Lee*	*Barro-Lee*	*Cohen-Soto*	*IV Barro-Lee*
	(1)	(2)	(3)	(4)	(5)	(6)
FRACTs,c	-0.9647	-0.9873	-1.0007	-0.9804	-1.0024	-1.0188
	(3.72)	*(3.46)*	*(3.44)*	*(3.66)*	*(3.47)*	*(3.37)*
Human Capital Accumulation Interaction	0.0196	0.0206	0.0366	0.1521	0.0867	0.2136
[*Δ(SCH9080)* X *HCINT*]	*(3.75)*	*(2.46)*	*(2.54)*	*(3.49)*	*(2.01)*	*(2.30)*
Human Capital Quantity Interaction	0.0040	0.0029	0.0046	0.0480	0.0348	0.0614
[*SCH80* X *HCINT*]	*(2.87)*	*(2.54)*	*(2.79)*	*(3.40)*	*(2.65)*	*(2.73)*
Other Controls	Financial Development X Growth Opportunities [*PRIV* X *OPPORT*]; Financial Development X Trade Affinity [*PRIV* X *TRADEINT*]; Property Rights Protection X Intangibility Intensity [*PROP* X *INTANG*]					
Adjusted R2	0.264	0.273	0.308		0.272	0.3248
Obs	1207	1131	1121		1131	1121
Countries	40	38	37	40	38	37
Industry-Country Fixed-Effect	Yes	Yes	Yes	Yes	Yes	Yes

The dependent variable is the annual real growth rate of value added at the industry-country level for the period 1980-1989 (GROWTHs,c). FRACTs,c indicates the industry share in total value added in manufacturing in 1980. The human capital accumulation interaction is the product of industry-level human capital intensity (HCINT) and the country-level change in average years of schooling over the 1970-1980 period (ΔSCH). The human capital quantity (years of schooling) interaction is the product of industry-level human capital intensity (HCINT) and country-level average years of schooling in 1980 (SCH80). In columns (1) and (4) we use schooling data from Barro and Lee (2001). In columns (2) and (5) we use schooling data from Cohen and Soto (2002). Columns (3) and (6) report instrumental-variables estimates using Cohen-Soto changes in schooling and the initial schooling level as instruments for the corresponding Barro-Lee variables. The models estimated in colu (4)-(6) rely on the logarithmic change in schooling and the log level of schooling in 1980.

All specifications also include (coefficients not reported): A finance trade credit interaction, defined as the product of an industry-level measure of trade credit dependence (TRADEINT) and the country-level financial development in 1980 (PRIV); a finance growth opportunities interaction, defined as the product of an industry-level measure of global industry growth opportunities (OPPORT) and country-level financial development in 1980 (PRIV); and a property rights interaction, defined as the product of industry dependence on intangible assets (INTANG) and a country-level measure of property rights protection (PROP). The Data Appendix gives more detailed variable definitions and the sources of the data. All specifications include country and industry fixed effects. Absolute val of t-statistics based on robust standard errors are reported in parenthesis and italics below the coefficients.

Table X-Further Robustness Checks

Panel A: Dependent Variable: Value Added Growth

	Physical Capital		Property Rights		GDP Level		GDP Growth	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FRACTs,c	-0.9542	-0.9723	-0.9517	-0.9749	-0.9656	-0.9826	-0.9330	-0.9759
	(3.45)	*(3.49)*	*(3.51)*	*(3.54)*	*(3.65)*	*(3.61)*	*(3.47)*	*(3.55)*
Human Capital Accumulation Interaction	0.0126	*0.0107*	0.0118	0.0094	0.0135	0.0117	0.0130	0.0117
[*Δ(SCH9070) X HCINT*]	(3.92)	*(3.55)*	*(3.68)*	*(3.04)*	*(4.13)*	*(3.76)*	*(3.91)*	*(3.77)*
Human Capital Quantity Interaction	0.0004		0.0016		-0.0011		0.0031	
[*SCH70 X HCINT*]	*(0.32)*		*(0.95)*		*(0.57)*		*(2.09)*	
Human Capital Quality Interaction		0.0477		0.0708		0.0452		0.0838
[*LFQUAL X HCINT*]		*(2.21)*		*(2.88)*		*(1.62)*		*(2.94)*
GDP Level - Human Capital Intensity Interaction					0.0183	0.0104		
[*Y70 X HCINT*]					*(3.66)*	*(2.85)*		
Physical Capital/Output - Human Capital Intensity	0.0246	0.0139						
[*K70/Y70) X HCINT*]	*(1.69)*	*(1.08)*						
Property Rights - Human Capital Intensity Interaction			0.0047	-0.0013				
[*PROP X HCINT*]			*(0.69)*	*(0.26)*				
GDP growth - Human Capital Intensity							-0.0235	-0.3956
[*GROWTH9070 X HCINT*]							*(0.12)*	*(1.90)*
Other Controls	Financial Development X Growth Opportunities [*PRIV* X *OPPORT*]; Financial Development X Trade Affinity [*PRIV* X *TRADEINT*]; Property Rights Protection X Intangibility Intensity [*PRO* P X *INTANG*]							
Adjusted R2	0.257	0.260	0.252	0.258	0.259	0.262	0.251	0.261
Obs	1171	1171	1171	1171	1171	1171	1171	1171
Countries	39	39	39	39	39	39	39	39
Industry-Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table X-Further Robustness Checks (cont.)

Panel B: Dependent Variable: Employment Growth

	Physical Capital		Property Rights		GDP Level		GDP Growth	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FRACTs,c	-0.1619	-0.1748	-0.1434	-0.1650	-0.1507	-0.1746	-0.1408	-0.1745
	(1.46)	*(1.55)*	*(1.34)*	*(1.50)*	*(1.45)*	*(1.63)*	*(1.34)*	*(1.61)*
Human Capital Accumulation Interaction	0.0080	0.0062	0.0083	0.0049	0.0088	0.0063	0.0094	0.0072
[*Δ(SCH9070) X HCINT*]	*(4.64)*	*(3.91)*	*(4.88)*	*(2.98)*	*(4.89)*	*(3.85)*	*(5.31)*	*(4.38)*
Human Capital Quantity Interaction	0.0018		0.0035		0.0028		0.0040	
[*SCH70 X HCINT*]	*(2.25)*		*(3.35)*		*(2.31)*		*(4.59)*	
Human Capital Quality Interaction		0.0355		0.0572		0.0487		0.0765
[*LFQUAL X HCINT*]		*(2.39)*		*(3.68)*		*(2.63)*		*(4.39)*
GDP Level - Human Capital Intensity Interaction					0.0052	0.0068		
[*Y70 X HCINT*]					*(1.63)*	*(2.91)*		
Physical Capital/Output - Human Capital Intensity	0.0196	0.0185						
[*K70/Y70) X HCINT*]	*(2.53)*	*(2.86)*						
Property Rights - Human Capital Intensity Interaction			0.0021	0.0027				
[*PROP X HCINT*]			*(0.46)*	*(0.94)*				
GDP growth - Human Capital Intensity							-0.0949	-0.3900
[*GROWTH9070 X HCINT*]							*(0.83)*	*(3.64)*
Other Controls	Financial Development X Growth Opportunities [*PRIV* X *OPPORT*]; Financial Development X Trade Affinity [*PRIV* X *TRADEINT*]; Property Rights Protection X Intangibility Intensity [*PRO* P X *INTANG*]							
Adjusted R2	0.448	0.450	0.437	0.439	0.438	0.444	0.437	0.447
Obs	1094	1094	1094	1094	1094	1094	1094	1094
Countries	39	39	39	39	39	39	39	39
Industry-Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes to Table X

In Panel A the dependent variable is the annual growth rate of real value added for the period 1980-1989 (GROWTHs,c). In Panel B the dependent variable is the annual growth rate of employment for the period 1981-1990 (EMPGRs,c). FRACTs,c indicates the industry share in total value added in manufacturing in 1980. The human capital accumulation interaction is the product of industry-level human capital intensity (HCINT) and the country-level change in average years of schooling over the 1970-1990 period (ΔSCH). The human capital quantity (years of schooling) interaction is the product of HCINT and country-level average years of schooling in 1970 (SCH70). The human capital quality (schooling quality) interaction is the product of HCINT and an indicator of the country-level quality of the labor force (LFQUAL). The interaction between productivity level and industry human capital intensity is the product of the logarithm of GDP per worker (Y) in 1970 and industry-level human capital intensity (HCINT). The interaction between the physical capital-output ratio and industry human capital intensity is the product of the logarithm of the physical capital to GDP ratio (K/Y) in 1970 and industry human capital intensity (HCINT).

The interaction between property rights and industry human capital intensity is the product of property rights protection (PROP) and the industry human capital intensity (HCINT). The interaction between productivity growth and industry human capital intensity is the product of the logarithmic growth rate of GDP per worker (GROWTH) over the 1970-1990 period and industry human capital intensity (HCINT). All specifications also include (coefficients not reported): A finance trade credit interaction, defined as the product of an industry-level measure of trade credit dependence (TRADEINT) and the country-level financial development in 1980 (PRIV); a finance growth opportunities interaction, defined as the product of an industry-level measure of global industry growth opportunities (OPPORT) and country-level financial development in 1980 (PRIV); and a property rights interaction, defined as the product of industry dependence on intangible assets (INTANG) and a country-level measure of property rights protection (PROP).

The Data Appendix gives more detailed variable definitions and the sources of the data. All specifications include country and industry fixed effects. Absolute values of t-statistics based on robust standard errors are reported in parenthesis and italics below the coefficients.