Capital Imports Composition, Complementarities, and the Skill Premium in Developing Countries*

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Abstract

We study how the composition of capital imports affects relative demand for skill and the skill premium in a sample of developing economies. Capital imports *per se* do not affect the skill premium; their composition does. While imports of R&D-intensive capital equipment raise the skill premium, imports of less innovative equipment lower it. We estimate that R&D-intensive capital is complementary to skilled workers, whereas less innovative capital equipment is complementary to unskilled labor—which explains the composition effect. This mechanism has substantial explanatory power. Variation in tariffs, freight costs and distance resistance to trade, over time and across types of capital, favors imports of skill-complementary capital over other types. This implies that trade liberalization increases inequality through the composition channel.

JEL classifications: F14, F16, J23, J24, J31, O10, O30

Keywords: Capital imports; capital-skill complementarity; skill premium; trade liberalization

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1 Introduction

The concurrent rise in trade flows and increase in the skill premium in several developing countries is one of the most striking economic phenomena of the 1980s and 1990s (Goldberg and Pavcnik (2007)), and has prompted many economists to ask: Is there a causal relationship between the two? And if so, what is the mechanism? The failure of standard Heckscher-Ohlin theory to explain distributional changes across skill groups in developing countries has shifted focus to more nuanced forms of competition in the final goods space, or to other channels through which globalization may affect factor prices.[1] [2]

In this paper we empirically study a new channel: Variation in the composition of capital equipment imports. While other papers highlight the role of capital imports under the assumption of capital-skill complementarity (Griliches (1969)) within structural quantitative trade models (Burstein, Cravino, and Vogel (2013), Parro (2013)), this paper is the first to test the mechanism directly in a sample of developing countries. We find that capital imports *per se* do not affect the skill premium; rather, it is the *composition* of capital imports that matters. While imports of R&D-intensive capital equipment raise the skill premium, imports of less innovative capital equipment actually lower the skill premium. As Figure 1 illustrates, a high ratio of R&D-intensive capital relative to less innovative capital imports (henceforth, the capital import ratio) is associated with larger increases in the skill premium, while the overall level of capital imports does not matter. This is the first contribution of this paper. We then investigate why this is the case.

We find that only R&D-intensive capital equipment is complementary to skilled labor; in contrast, we find that less innovative capital equipment is complementary to unskilled labor. To our best knowledge, we are the first to empirically document that some types of capital are more complementary to unskilled workers. Acemoglu (2002) suggests an explanation for why this is the case: An increase in the supply of skilled labor in industrial economies, which occurred during the same period that we study, "directs" more innovation and resources (read: R&D expenditures) towards developing skill-complementary machines, and relatively less towards machines that are complementary to unskilled workers (the "market size effect").[3]

[1] See Feenstra and Hanson (1996), Zhu and Trefler (2005), Yeaple (2005), Zeira (2007), Verhoogen (2008), Bustos (2011), Burstein and Vogel (2012), Harrigan and Reshef (2012) and Bonfatti and Ghatak (2013). Harrison, McLaren, and McMillan (2011) provide a recent survey.

[2] The failure to detect Stolper-Samuelson effects in skill abundant countries, let alone in unskilled abundant countries, together with scant evidence of industry reallocations due to trade liberalization, have prompted many researchers to abandon the trade explanation altogether and focus on technological explanations, for example Berman, Bound, and Griliches (1994) and Machin and Van Reenen (1998). However, see also Bernard and Jensen (1997) for evidence on the importance of trade-induced changes in demand for skill and reallocations across plants within industries.

[3] Similar ideas are investigated in Galor and Moav (2000), but the framework in Acemoglu (2002) is more closely

In the model of Acemoglu (2003) technology firms in less developed countries copy blueprints of machines from developed countries (at some cost), produce them domestically, and sell to final goods producers. If the ability to successfully copy is not available or is not optimal, then importing machines from developed countries is another way to obtain the technology that they embody. Our work focuses on this channel of embodied technology diffusion. Indeed, developing countries import much of their equipment, which originates mostly in developed, skill abundant countries (Eaton and Kortum (2001)); therefore, we can treat capital imports as a good measure of investment in developing countries (Caselli and Wilson (2004)). We present detailed evidence that supports both these arguments. Therefore, it is reasonable to infer the characteristics of capital investment in developing economies based on data from developed economies.

We expect to see the skill premium rise more when the composition of capital imports (investment) becomes more R&D intensive. This happens when the relative price of skill-complementary capital decreases, shifting imports towards R&D-intensive capital and hence increasing the capital import ratio. This, in turn, shifts the composition of the capital stock towards more skill-complementary capital, and increases demand for skill. The explanatory power of this mechanism is economically large: An increase in one standard deviation of the capital import ratio increases the change in the skill premium by more than one standard deviation, all else equal.

Finally, we ask *whether* trade liberalization generally increases the skill premium. The capital composition mechanism described above only tells us *how* trade liberalization *may* increase the skill premium. In this context, the question is whether trade liberalization shifts the distribution of capital imports towards more skill-complementary equipment.[4] We provide evidence that is consistent with this.

We show that tariffs and freight costs for skill-complementary capital imports dropped more than for unskilled-complementary equipment. We also show that gravity resistance of distance to trade increased differentially fell for skilled-complementary equipment relative to unskill-complementary capital imports—both for developing countries and more generally. These effects are economically large: A reduction of a factor of 0.72 in relative tariffs in 1988–2010, a reduction of a factor of 0.44 in relative freight costs in 1983–2004, and a relative decrease in distance elasticity of 0.09 in absolute value in 1984–1999. In addition, we show that in levels, tariffs and freight costs are lower for skill-complementary capital imports, and that distance resistance is higher for unskilled-complementary capital imports—which is relevant for the small set of countries that apply tariffs

related to ours. Both are reminiscent of historical accounts of innovation and demand for skill in Goldin and Katz (2008).

[4]In our sample of developing countries the average change in the skill premium is close to zero. However, these countries increased their skill abundance significantly (see Table 2). Therefore there is no contradiction between our mechanism and observing no average change in the skill premium in the sample of developing countries.

to FOB (free on board) import prices, rather than to CIF (cost, insurance, freight) prices. These findings imply a decrease in the relative price of skill-complementary capital versus less innovative equipment, which increases the import ratio. Therefore, on average, trade liberalization increases inequality through the composition channel.

This paper contributes to three broad strands of literature: Trade liberalization and changes in relative demand for skill; Capital-skill complementarity; and Computers and relative demand for skill. First, we provide empirical evidence for a new mechanism that links trade liberalization and relative factor demand in developing countries—through the composition of capital imports. Caselli and Wilson (2004) document broad cross-country variation in the composition of capital imports by R&D intensity. They link this composition to differences in total factor productivity. Coe and Helpman (1995) and Acharya and Keller (2009) investigate the role of aggregate imports in facilitating R&D spillovers and technology transfers. None of these studies address changes in relative demand for skill and distributional consequences. Burstein, Cravino, and Vogel (2013) and Parro (2013) assume that aggregate capital is complementary to skill, but do not test whether this is indeed the case.

Our work is also related to Koren and Csillag (2012), who show how imports of machines increase the wages of workers whose occupations are particularly complementary to those machines. While their estimates focus on micro, within-worker effects in Hungary alone, we address relative demand shifts for the entire economy, in 20 developing countries. Zhu and Trefler (2005) offer an elegant general equilibrium model and show how trade liberalization may increase demand for skill in developing countries through shifts in the composition of exports towards skill intensive goods. We exploit similar data in our analysis, and find that empirically their mechanism is orthogonal to ours. We also demonstrate that the capital imports composition mechanism has substantially stronger explanatory power for the skill premium—3.5 times larger in terms of standard deviations.

We highlight the effects of trade liberalization through the input side of production. For example, Amiti and Konings (2007) study how greater access to inputs increases productivity, and Goldberg, Khandelwal, Pavcnik, and Topalova (2010) show how this may have an effect on growth in the number of products produced. Amiti and Davis (2012) find that trade liberalization increases average wages at firms that import more intermediate inputs in Indonesia, and offer a fair-wage mechanism to explain their findings. However, they do not investigate distributional effects. Our work can help explain results in Amiti and Cameron (2012), who find that imports of intermediate inputs tend to lower skill premia within firms in Indonesia.[5] Amiti and Cameron (2012) do not study complementarities of intermediate inputs with skilled and unskilled labor, and their results

[5] Indonesia is not one of the countries in our sample.

are confined to firms that actually import. While our results pertain to the entire economy, we conjecture that similar forces (composition in conjunction with complementarities) drive their results. Saravia and Voigtländer (2012) argue that high quality intermediate inputs substitute for skilled workers, but that the quality gains at the firm output level increase returns to employing skilled workers. In contrast to all these studies, we focus on aggregate, economy-wide relative demand effects that are not confined to importing firms alone. Thus, while our approach is less forensic in nature, we capture broader implications.

Second, we contribute to the literature on capital-skill complementarity. Since the seminal work of Griliches (1969) it has become standard to assume that capital is complementary to skilled labor. Several studies adopt this framework in order to address questions on economic growth, trade, and inequality.[6] This work uses an aggregate measure of capital; in contrast, we show that complementarities vary systematically at disaggregated levels. Our analysis reveals that it is the most innovative, R&D-intensive capital that is complementary to skilled workers, while other types of capital are in fact complementary to the unskilled. These results are robust to different definitions of skill. Our findings can help explain the lack of robustness in previous attempts to test the aggregate capital-skill complementarity hypothesis, e.g. Duffy, Papageorgiou, and Perez-Sebastian (2004): Differences in the composition of capital across countries and over time may render the overall characterization of complementarity elusive.

Finally, our work is also related to the literature on computers and demand for skill. We find that the R&D-intensive, skill-complementary capital is, to a first approximation, mostly composed of information and communications technology (ICT) equipment. The work of Autor, Katz, and Krueger (1998), Bresnahan, Brynjolfsson, and Hitt (1999), and Autor, Levy, and Murnane (2003) all indicate that this type of equipment raises relative demand for skilled labor, although their empirical results focus on the U.S. Michaels, Natraj, and Van Reenen (2011) study the effect of ICT capital deepening on polarization of labor demand in developed countries. They find that ICT deepening reduces relative demand for medium-skilled workers, while increasing relative demand for high skill workers.[7] While we take advantage of similar distinctions between types of capital in some of our specifications, we investigate in greater detail the pattern of complementarities across more disaggregate types of capital, relate this pattern to R&D intensity, and find that other types of capital are actually complementary to unskilled labor—a new result. In addition, we apply our results to imports in developing countries.

[6] For example, Stokey (1996), Krusell, Ohanian, Rios-Rull, and Violante (2000) and the aforementioned Burstein, Cravino, and Vogel (2013) and Parro (2013).

[7] For evidence on polarization and for the "routinization" hypothesis see Goos and Manning (2007) for the U.K., Autor, Katz, and Kearney (2006) for the U.S., and Goos, Manning, and Salomons (2009) for European and other developed countries.

After introducing the framework that underpins our analysis in Section 2, in Section 3 we document the strong effect of the composition of capital imports on the skill premium. In Section 4 we show that more R&D-intensive capital equipment is complementary to skilled labor, and that less innovative capital equipment is complementary to unskilled labor. Section 5 argues that trade liberalization increases inequality through the composition channel. Section 6 concludes.

2 Analytical framework

In this section we lay out a simple analytical framework to help organize the discussion. Since we are considering developing countries, we ignore the possibility to produce capital goods domestically, but allow them to import capital goods, whose prices are given internationally. We make an Armington assumption and let final goods be differentiated by country of production. We ignore balanced trade considerations, since these are not essential to the analysis here.

There are two types of capital—C and K (think computers and tractors, respectively)—and two types of labor—skilled H and unskilled L. The aggregate production function for the economy is

$$Q = \left[\delta X^{\frac{\sigma-1}{\sigma}} + (1-\delta)\, Y^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} ,$$

where

$$\begin{aligned} X &= H^{\beta} C^{1-\beta} \\ Y &= L^{\beta} K^{1-\beta} , \end{aligned}$$

$\beta \in (0,1)$ and $\sigma > 1$. The critical assumption here is that each type of capital is more complementary to one type of labor than with the other: C with H, and K with L. Any production function that maintains this property will suffice. We devote Section 4 to justifying this assumption. Adopting a Cobb-Douglas framework in X and Y implies that the degree of complementarity between C and H is the same as that between K and L; some of our estimates in Section 4 are consistent with this. Allowing β to vary across X and Y complicates the discussion without providing additional insight; and in fact, the estimates in Section 3 are consistent with this assumption.[8] Estimates of the aggregate elasticity of substitution between H and L in the literature are typically above unity; this implies $\sigma > 1$.[9]

[8] In Tables 6 and 7 the coefficients to skill-complementary and unskilled-complementary capital equipment are very similar in absolute value. Acemoglu (2002) also makes this assumption to streamline his model.

[9] The elasticity of substitution between between H and L in the current framework is $\sigma / \left[\sigma - \beta\left(\sigma - 1\right)\right]$. If this is greater than unity, then so is σ, given $\beta \in (0,1)$. For the U.S., Katz and Murphy (1992) estimate an aggregate elasticity of substitution between college and high-school graduates at 1.4. More recent estimates are reported by Heckman, Lochner, and Taber (1998) at 1.44, and Krusell, Ohanian, Rios-Rull, and Violante (2000) at 1.67. Despite

Workers supply labor—both H or L— inelastically. Denote the wage of skilled labor by w_H and the wage of unskilled labor by w_L. Denote the price of capital as r_j for $j \in \{C, K\}$. We ignore depreciation rates, which do not affect our analysis unless they vary systematically over time, which is unlikely. Competitive factor markets imply that factors are paid the value of their marginal product.

Some algebra (see appendix) yields

$$\omega = \frac{\delta}{1-\delta}\left(\frac{H}{L}\right)^{-\frac{\sigma-\beta(\sigma-1)}{\sigma}}\left(\frac{C}{K}\right)^{\frac{(1-\beta)(\sigma-1)}{\sigma}}, \tag{1}$$

where $\omega \equiv w_H/w_L$. Holding constant C/K, greater skill abundance H/L reduces the relative wage of skilled labor ω. Holding constant H/L, a greater C/K ratio also increases ω as long as $\sigma > 1$.[10] Equation (1) also shows that the overall quantity of capital $C + K$ is not important for determining ω: Only the composition matters.

Taking logs of (1) we have

$$\ln \omega = \kappa - \alpha \ln\left(\frac{H}{L}\right) + \lambda \ln\left(\frac{C}{K}\right), \tag{2}$$

where $\kappa = \ln[\delta/(1-\delta)]$, $\alpha = 1 - \beta(\sigma-1)/\sigma$, and $\lambda = (1-\beta)(\sigma-1)/\sigma$. Taking differences of (2) yields

$$\Delta \ln \omega = -\alpha \Delta \ln\left(\frac{H}{L}\right) + \lambda \Delta \ln\left(\frac{C}{K}\right). \tag{3}$$

The empirical counterpart to (3) includes country fixed effects (e.g., due to variation in changes in industrial structure δ) and other controls. We also include time effects to deal with common unobserved trends (e.g., disembodied technological change).

We use the framework to identify a valid instrument for C/K. Similar derivations to those that give (1) yield (see appendix)

$$\frac{C}{K} = \left(\frac{\delta}{1-\delta}\right)^{\frac{\sigma}{\sigma-(1-\beta)(\sigma-1)}}\left(\frac{H}{L}\right)^{\frac{\beta(\sigma-1)}{\sigma-(1-\beta)(\sigma-1)}}\left(\frac{r_C}{r_K}\right)^{-\frac{\sigma}{\sigma-(1-\beta)(\sigma-1)}}. \tag{4}$$

Higher relative prices r_C/r_K lower relative demand C/K (since $\sigma - (1-\beta)(\sigma-1) > 0$ always, as demonstrated in the appendix). An increase in H/L increases C/K as long as $\sigma > 1$ (holding

estimating an elasticity of substitution in services at less than one, Reshef (2013) estimates an aggregate elasticity (that takes into account substitution across sectors, not just within) above one.

[10] When $\sigma < 1$ strong complementarity between X and Y change the direction of the effect. Take the extreme case of $\sigma = 0$, i.e. fixed proportions in X and Y. An increase in C/K increases the relative supply of X/Y, but since there is no substitution we do not need as much X and hence demand for skilled labor falls.

constant r_C/r_K).[11] Taking logs of (4) and then differencing yields

$$\Delta \ln \left(\frac{C}{K}\right) = \rho \Delta \ln \left(\frac{H}{L}\right) - \varphi \Delta \ln \left(\frac{r_C}{r_K}\right) \ , \quad (5)$$

where $\rho = \beta (\sigma - 1) / [\sigma - (1 - \beta)(\sigma - 1)]$ and $\varphi = \sigma / [\sigma - (1 - \beta)(\sigma - 1)]$. Together, equations (3) and (5) imply that relative capital prices r_C/r_K affect ω only through their effect on C/K. This means that r_C/r_K is a valid instrument for C/K in (3). We exploit this property in the empirical analysis below.

By plugging (5) into (3) we can derive an equation for $\Delta \ln \omega$ in terms of $\Delta \ln (H/L)$ and $\Delta \ln(r_C/r_K)$ alone. While this is theoretically aesthetic, empirically it is less successful, as we demonstrate below. The explanatory power of our proxies for r_K and r_C is much weaker than our proxy for $\Delta \ln (C/K)$, which is the log of the import ratio. Moreover, empirically, in the presence of the capital import ratio, our proxies for r_C and r_K have no explanatory power, which validates their excludability and use as instruments.

Before turning to the empirical analysis we make the following observation. An alternative interpretation of Q is utility over a skill intensive good X and a skill un-intensive good Y. This would open the door to production and export composition effects that are reminiscent of Zhu and Trefler (2005) (henceforth, ZT)—but for different reasons and through a different mechanism. We shut down this channel in our framework for two reasons. First, using data from the EU-KLEMS dataset (O'Mahony and Timmer (2009)) we find that changes in empirical counterparts of C and K do not induce large changes in relative demand for skill via changes in the industrial composition alone (see details in the appendix). Second, the changes in export shares towards skill intensive goods in ZT (their Δz) are virtually uncorrelated with the composition of capital imports (see Table 2). We conclude that the mechanism highlighted in ZT is orthogonal to ours. This may not be surprising, since ZT examine only changes in export shares, while capital imports can affect the entire economy, not only the tradable sectors.

3 Capital imports and the skill premium

In this section we demonstrate that the composition of capital imports explains changes in skill premia in developing countries, whereas overall capital imports do not. We focus on the 1980s and 1990s, during which many developing countries—and specifically the ones in our sample—liberalized their international trade regimes.[12]

[11] The effects depends on σ for reasons discussed in footnote above.

[12] For instance, data from the World Bank's World Development Indicators (available at: http://data.worldbank.org/data-catalog/world-development-indicators) reveal that the average increase between

3.1 Data

Since we do not have empirical equivalents for C and K for developing countries, we rely on imports of capital to approximate changes in capital stocks, i.e. investment. This is a reasonable assumption for the developing countries in our sample, since they import most of their capital during our period of interest. We document this fact in detail in Section 3.2 below, as well as the tight correlation between imports and "implied investment" (defined below).

All trade data are from Feenstra, Lipsey, Deng, Ma, and Mo (2005). We break down total capital imports (M) into imports of R&D-intensive capital (M_H), imports of relatively R&D-unintensive capital (M_L), and imports of capital with intermediary R&D intensity (M_N). R&D intensity ranking of capital goods in 1980 is taken from Caselli and Wilson (2004) and are briefly described in Table 1. Their ranking of nine types of equipment is based on estimates of world R&D expenditures divided by world sales for each capital good; it is the same whether R&D flows or stocks (perpetual inventory method) are used. M_H includes the three most R&D-intensive capital equipment, while M_L includes four of the least R&D-intensive capital equipment. The remainder two types of capital are separately aggregated in M_N because—as demonstrated in Section 4 below—their complementarity is not stronger with either skilled or unskilled labor. These two types of equipment have less than half the R&D intensity (however measured) as equipment included in M_H. Our empirical equivalents of C and K are R&D-intensive and R&D-unintensive capital, respectively.

We merge import data with data on changes in relative skilled wages from Zhu and Trefler (2005), which encompass the most comprehensive sample of developing countries for which there are data on relative skilled wages in the time sample of interest. These are based on the availability of wages for non-production (skilled) and production workers in manufacturing from the International Labor Organization's occupational wage database. This has the advantage of direct comparability to ZT's results, and also relieves us from making judgements on sampling. The sample includes 58 observations covering 20 developing countries in 1983–1997, and is an unbalanced panel due to data availability.[13] Although the sample is relatively small, this is the best data and most relevant sample. Despite the small sample, the estimates are precise and surprisingly robust.

1980-1999 in the share of total trade in GDP for all countries in our sample is approximately 40%, having several countries more than doubling their trade share during this period, including Argentina, India, Mexico, Thailand, and the Philippines. Goldberg and Pavcnik (2007) provide evidence on trade-liberalizing policy changes during our period of interest in some of the countries in our sample, including Argentina, Mexico, India, and Hong Kong.

[13] The criterion for being considered a developing country is having real GDP per capita below $14,000 in 1980. The countries in the sample are: Algeria, Argentina, Barbados, Bolivia, Central African Republic, Cyprus, Honduras, Hong Kong, India, South Korea, Sri Lanka, Madagascar, Mauritius, Mexico, Philippines, Singapore, Thailand, Trinidad and Tobago, Uruguay, and Venezuela. See the appendix for the years in which each country is observed.

We use the relative wage of non-production to production workers (w_H/w_L) as our measure of skilled relative wages.[14] The ZT data include an additional variable of interest: The shift in skilled export shares (Δz), which measures the degree to which export shares shift towards more skill-intensive exports within a given period.[15] ZT argue that Δz can help explain changes in wage inequality; we examine below the relative importance of ZT's mechanism versus capital imports composition.

Our measure of aggregate relative supply of skilled labor (skill abundance) (H/L) uses data from Barro and Lee (2013). Skilled workers H have at least secondary education and unskilled workers L have less than that level of education. Educational attainment data are available every 5 years, so we linearly interpolate between observations within a country.

We use the following ancillary control variables. From the World Bank's World Development Indicators: Government, services and industrial shares in value added; a measure of financial development (M3/GDP); GDP and population. We use data on foreign direct investment (FDI) position of U.S. multinational firms from the Bureau of Economic Analysis. We also use the intellectual property rights protection index (IPR) from Ginarte and Park (1997), updated by Park (2008); these data are available every 5 years, so we linearly interpolate between observations within a country. Finally, we use the total capital stock data from Penn World Tables, mark 8.0.[16]

Table 2 reports descriptive statistics for the main variables of interest. During the sample (a period of trade liberalization) the skill premium has not uniformly fallen. Half of the countries in the sample experience rising inequality while the others experience decreasing inequality; overall, changes in w_H/w_L are roughly split between positive and negative changes. The log of the import ratio (M_H/M_L) is on average -0.74, which implies that R&D-unintensive capital imports are about twice as large in value relative to R&D-intensive capital imports ($e^{-0.74} \approx 0.5$).[17]

The correlation between Δz and $\ln(M_H/M_L)$ is 0.09. The low correlation implies that changes in capital stock composition in *production* are not tightly related to shifts in skilled *export* shares, as discussed in the end of Section 2. The upshot is that the mechanism that governs variation in Δz is different from the one driving variation in the import ratio.

We also find a notably low correlation of 0.01 between $\Delta \ln(H/L)$ and $\ln(M_H/M_L)$. This is

[14] Proxying skill by "non-production" is problematic, though it is common practice by necessity. Berman, Bound, and Griliches (1994) show that for the United States, the production/non-production worker classification is a good proxy for skilled and unskilled workers. In our estimation of complementarities below we entertain other definitions of skill.

[15] See appendix for details on the construction of Δz.

[16] Penn World Tables, mark 8.0 is available at the University of Groningen, http://citaotest01.housing.rug.nl/febpwt/Home.mvc.

[17] There are only 8 observations in which $M_H > M_L$; 16 countries consistently import more M_L than M_H in all periods; in 17 countries the total M_L imports over the sample are larger than the total of M_H imports.

important because, as we discuss below in more detail, the potential endogeneity of $\Delta \ln (H/L)$ does not bias the estimator of the coefficient to $\ln(M_H/M_L)$.

3.2 Imports and investment

In this section we make two important points: First, that capital imports account for most of the investment in the sample of countries that we examine; and second, that capital imports are strongly correlated with investment. Before doing so, we describe the distribution of capital imports and changes thereof.

Table 3, Panel A reports the distribution of capital imports. There is substantial variation in these shares across countries in our sample. On average, the shares of M_H, M_N and M_L are 20%, 27% and 53%, respectively. Panel B documents substantial variation across countries in the changes in these shares in 1983–1997. On average, the reduction of 7% in the share of M_L is completely offset by an increase in the share of M_H. Capital imports become more R&D intensive and more skill-complementary over time.

We now assess the importance of capital imports in "implied investment", which is domestic absorption of capital equipment

$$I = Y + M - X \ ,$$

where Y is output, M are imports and X are exports. Output data on capital equipment are from UNIDO (2013), and are available at the 2-digit ISIC Rev.3 classification. The 2-digit classification allows aggregating to the three main groups H, N, L that are also used for imports and exports. The only mismatch is for aircraft equipment, which cannot be separated from "other transport equipment", and is allocated to Y_L.[18] The main limitation of these data is that country and year coverage are sparse for our sample. Nonetheless, the data are informative. We match import data to output data for all possible observations.

Table 4 reports the share of imports in implied investment. On average, M_H are 95% of H-type investment, with the notable outliers of Korea (which produces and exports much of this equipment) and Mexico (where implied investment is negative due to large exports from the *Maquiladora* sector). Here M_N and M_L are 67% and 72% of the respective investment type. Overall, imports are 70% of investment. We also report shares of net imports ($= M - X$) in investment. Net imports can help offset the effect of importing intermediate inputs that are assembled and then exported, when both flows fall within the same classification. Although the shares of net imports

[18] The relevant 2-digit ISIC Rev.3 categories are: 28 Fabricated metal products, 29 Machinery and equipment n.e.c., 30 Office, accounting and computing machinery, 31 Electrical machinery and apparatus, 32 Radio,television and communication equipment, 33 Medical, precision and optical instruments, 34 Motor vehicles, trailers, semi-trailers, 35 Other transport equipment. Y_H includes $30 + 32$, Y_N includes 33+33, and Y_L includes $28 + 29 + 31 + 35$.

in investment are lower, they are still substantial, especially for H-type investment.

Next, we turn to the correlation of imports with implied investment. Table 5 reports pairwise correlation coefficients between three types of implied investment and capital imports or net imports, of the respective kind. In addition, the table reports correlations of total investment with total capital imports or net imports. By and large, imports and net imports are highly correlated with investment. The exceptions occur for countries that are big exporters of capital of a particular type, where net imports are negatively correlated with investment. This is a consequence of output being strongly correlated with exporting for these cases. For example, Korea is a big exporter of all capital types; India exports L-type, but not H-type capital. We stress that the regression results in the next two sections are robust to the exclusion of these countries.

The takeaway message is that capital imports are a good approximation for investment. It is likely to be particularly good for H-type investment, since developing countries rely much more on imports of R&D-intensive capital, relative to R&D-unintensive capital.

3.3 OLS estimates

We now turn to testing our main hypothesis. Equation (3) implies a relationship between changes in relative skilled wages and changes in the ratio of skill-complementary to unskilled-complementary capital (C/K), but not with overall levels of capital ($C+K$). We approximate changes in C/K with the import ratio. Changes in $\ln(C/K)$ do not map precisely into $\ln(M_H/M_L)$. Therefore, we experiment with several specifications: We use each type of capital imports as a ratio to GDP, to population and to the total capital stock, or simply in logs. We also use M_H/M_L (not in logs). The results are not qualitatively sensitive to these changes.

We estimate regressions of the type

$$\Delta \ln \omega_{it} = \lambda \ln \left(\frac{M_H}{M_L}\right)_{it} + \theta \ln \left(\frac{M}{GDP}\right)_{it} + \alpha \Delta \ln \left(\frac{H}{L}\right)_{it} + \gamma_i + \delta_t + \varepsilon_{it} \ , \qquad (6)$$

where $\omega = w_H/w_L$, and γ_i and δ_t are country and period fixed effects, respectively. This is the empirical counterpart to Equation (3). Due to data constraints each period t is of different length, so changes are annualized. On average, each country is observed in three periods; see the appendix for the years in each period across countries. We normalize overall capital imports by GDP. Variables not in changes are averaged within the period in order to be consistent with the annualized changes. The coefficients of interest are λ and θ. Our hypothesis is that $\lambda > 0$ and $\theta = 0$.

Table 6 reports the results. All regressions include country fixed effects. In column 1 we see that indeed the import ratio is positively correlated with increases in the relative skilled wage: The partial R-squared of the import ratio in this regression is 0.35 (this is the underlying regression for

Figure 1-A). In contrast, column 2 shows that overall imports of capital equipment do not affect changes in inequality.

Columns 3 and 4 deliver the main message of this section: Even in the presence of overall capital imports, only the composition matters for changes in relative skilled wages. Although the specification in column 3 renders marginal statistical significance to $\ln(M/GDP)$, the explanatory power is 3.7 times less than the import ratio. Adding period fixed effects in column 4 renders the coefficient to $\ln(M/GDP)$ statistically insignificant, while only enhancing the explanatory power of the import ratio. A one standard deviation increase in the import ratio increases the change in the skill premium by 1.2–1.4 standard deviations. This is a large effect.

Columns 5–6 show that both the numerator M_H and the denominator M_L of the import ratio have explanatory power—in opposite directions—and that M_H has somewhat more explanatory power. Imports of intermediate level R&D intensity capital imports M_N are not correlated with changes in the skill premium. The separate coefficients are precisely estimated whether or not we include period dummies. The coefficients to $\ln(M_H/GDP)$ and $\ln(M_L/GDP)$ are very similar in absolute value, which is consistent with our assumption of fixed output elasticities (β) in Section 2 above.

The rest of Table 6 is devoted to robustness checks. First, in column 7 we add Δz: This reduces somewhat the magnitude of the coefficient to the import ratio, but the separate effect remains large. Moreover, the explanatory power of the import ratio is 3.5 times that of Δz.[19] This may not be surprising, because capital imports potentially affect demand for skill in all sectors of the economy, while Δz affects demand for skill directly only in the export sector.

In columns 8–9 we add to Δz a set of ancillary control variables. We add them first in changes, which we think as the more appropriate specification, but also in levels (averages within periods). In a nutshell, all these additional controls do not affect the main conclusion of this section.

If multinationals are important actors that import equipment, and if they employ superior disembodied technology that is also skill biased, then omitting their activity may induce a bias to the estimator of the coefficient to the import ratio. Note that both premises need to be true in order to create bias. To control for this potential bias we add FDI position of U.S. multinational firms in the target country. If economic development is itself a skill-biased process that also increases incentives for more skill-complementary imports, then this would again induce bias. In order to control for this we add GDP per capita. Next, we add shares in value added of the industrial (manufacturing), government and services sectors. These may capture the effect of structural

[19] For Δz $0.51 \times 0.02 = 0.0102$, and for the log import ratio $0.049 \times 0.73 = 0.03577$; these represent 30% and 86% of the standard deviation of $\Delta \ln \omega$ (0.034).

change on the skill premium. We also add a proxy for financial development (M3 money supply divided by GDP) to capture the ability to finance investment. Lastly, we add the IPR protection index to correct for potential bias if exporters are less likely to export R&D-intensive equipment to countries that do not enforce IPR, which in turn have inherently less demand for skill.[20] Adding these variables reduces the sample size to 48 observations.

Surprisingly, changes in U.S. multinational FDI position are negatively correlated with changes in the skill premium. This may be driven by multinationals implementing unskilled biased technology. Changes in IPR protection are only weakly correlated with the skill premium, both statistically and economically. All the ancillary control variables do not matter in levels.

Finally, in columns 10–12 we demonstrate the weak direct effect of our proxies for r_C and r_K (their construction is detailed in the next section) on the skill premium. First, notice that in column 10 the proxy for r_C and r_K are negatively and positively correlated with changes in the skill premium, respectively, as predicted by the theoretical framework. But the explanatory power of r_K and r_C is much lower than that of the import ratio. This happens for two reasons: First, we have only imperfect proxies for r_C and r_K, while the data on imports is more accurate. Second, since there is imperfect capital adjustment in the real world, we expect relative prices to have a weak, delayed effect on capital stocks. Moreover, in columns 11–12 we see that in the present of the import ratio or its separate components, the proxies for r_C and r_K have no additional explanatory power, which helps validating their excludability and use as instruments.

In the appendix we show that results are virtually the same both qualitatively and quantitatively in case we normalize capital imports by population or total capital stock, rather than by GDP, or do not normalize at all. In the appendix we also report estimates after dropping countries that export substantial amounts of capital goods: Hong Kong, India, Korea, Mexico, Philippines, Singapore, and Thailand. The results are robust to this, despite the fact that this leaves only 37 observations.

3.4 TSLS estimates

One potential concern is that variation in both capital imports and changes in inequality are driven by third factors. For example, technological shocks that are not Hicks-neutral or are sector-specific may drive up both demand for skilled labor and imports of specific types of equipment. Although we try to address this with the ancillary controls variables in Table 6, it remains a concern. An additional potentially endogenous variable in (6) is $\Delta \ln (H/L)$. We stress that since $\Delta \ln (H/L)$ is virtually uncorrelated with $\ln (M_H/M_L)$, any bias in the estimator of the coefficient to $\Delta \ln (H/L)$

[20] FDI, sectoral shares, financial development and intellectual property rights protection are also used by Caselli and Wilson (2004) as explanatory variables for capital imports.

does not affect the estimator of the coefficient to $\ln(M_H/M_L)$.

With that in mind, we construct the following instruments for capital imports. As implied by (3) and (5), prices of different types of capital are valid instruments for capital stocks, as long as these are determined internationally, and not influenced by domestic factors. We take this into account in the construction of the instruments.

The instruments capture supply shocks across capital types, which are importer and period specific. First, we calculate the average real unit value of exports for each capital type $j \in \{M_H, M_L, M_N\}$ from the three largest exporters that serve each country in each year in our sample, while dropping trade flows to the country at hand

$$uv_{i\tau}^{j} = \frac{\sum_{s \in TOP3_i^j} \sum_{d \neq i} X_{sd\tau}^{j}}{\sum_{s \in TOP3_i^j} \sum_{d \neq i} Q_{sd\tau}^{j}} \quad , \quad j \in \{M_H, M_L, M_N\} \ .$$

As before, i is the importing country, but τ denotes a calendar year, not a period (denoted t above). $TOP3_i^j$ denotes the set of three largest exporters that serve country i capital type j in the first year it is observed; X are exports and Q are physical quantities; s denotes a source country (exporter) and d denotes a destination (importer). We sum over all available destinations besides the country inspected. The unit values are then deflated by 1995 price indices that are specific to M_H or M_L, using deflators from the EU-KLEMS database (O'Mahony and Timmer (2009)). Finally, for each country we calculate the change in these unit values over the given period, i.e. our instruments are $\Delta \ln uv_{it}^j = \ln uv_{i2}^j - \ln uv_{i1}^j$, where 2 denotes the last year in the period and 1 denotes the first.

The $\Delta \ln uv_{it}^j$ are valid instruments as long as supply shocks in the set $TOP3_{i\tau}^j$ are not correlated with changes in the relative skilled wage. A priori, there is no reason to think so. The exclusion of country i's imports from the calculation of $uv_{i\tau}^j$ makes correlation with demand shocks in country i unlikely. These instruments are excludable on theoretical grounds: Relative demand for skill is not affected directly by prices of capital. And as discussed above, this prediction is born out empirically in Table 6, columns 10–11.

The instruments have independent variation by country, period and capital type. Cross-country variation is given by the heterogeneity of exporters. For example, the top three exporters of M_H in 1990 to Algeria are Sweden, France, and Japan; for Argentina they are the U.S., Japan and Germany. There is not much heterogeneity of exporters across capital groups within countries (a country's three largest international suppliers often supply it with both M_H and M_L). For example, in 1990 Hong Kong imported both M_H and M_L mostly from China, Japan, and the U.S. Nevertheless, unit values, and changes thereof, for different types of capital do have independent variation, as demonstrated in Figure A1 in the appendix.[21]

Table 7 reports the TSLS estimates. In all specifications we treat all capital imports as endogenous and instrument for them. Here, columns 1–7 in Panel A correspond to columns 3–9 in Table 6 ; the magnitudes of the coefficients, and consequently their explanatory power, remain similar.

In Panel B we report the relevant first stage estimates and statistics. The signs of the coefficients to the instruments are always in line with the theory: They affect negatively the corresponding type of capital imports.[22] Overall, the instruments are strong: The Shea (1997) partial R^2 are not substantially lower than the usual partial R^2, which are both relatively large; and the F-stat for weak instruments is usually above 10. The F-stat drops below 10 in specifications 3 and 4 only for M_N, and in specification 7 for $\ln(M_H/M_L)$. Specification 7 uses the ancillary control variables in levels, which is not the most relevant specification for $\Delta \ln \omega$. We investigate this first stage specification more thoroughly in the next section.

In the appendix we report estimates after dropping countries that export substantial amounts of capital goods: Hong Kong, India, Korea, Mexico, Philippines, Singapore, and Thailand—the results are robust to this, despite the fact that this leaves only 37 observations.

To summarize, we find that the composition of capital imports matters, not the overall quantity. These results hold both when using OLS and TSLS estimators. Imports of R&D-intensive equipment are associated with increases in the skill premium; imports of less innovative capital equipment are associated with decreases in the skill premium. In Section 4 we explain why this is the case.

3.5 Explaining the import ratio

In this section we investigate which factors determine the import ratio. The specifications resemble the first stage regressions of the TSLS estimation. We find that only prices of capital are robust and economically important predictors of the import ratio.

We interpret $\Delta \ln uv^j$ as proxies for log changes in capital prices.[23] Using proxies for prices introduces a measurement issue, where the coefficients to the proxies do not identify the parameter φ in (5). However, the exercise is informative due to the strong explanatory power of $\Delta \ln uv^{M_H}$

[21] Figure A1 in the appendix reports the annual rate of change in the average international real unit value of the two types of capital for 1985–1997; we start at 1985 given data availability on quantities traded. The figure exhibits significant and independent variation for both unit values. The correlation between the two variables is only 0.09.

[22] Figure A2 in the Appendix demonstrates this graphically for $\Delta \ln uv^{M_H}$ and $\Delta \ln uv^{M_L}$, which are negatively correlated with $\ln(M_H)$ and $\ln(M_H)$, respectively.

[23] These two variables are likely to satisfy the two conditions for proxy variables: Redundancy in the presence of true prices, and no correlation between the other regressors and the true prices once the proxy is controlled for (Wooldridge (2002), Chapter 4).

and $\Delta \ln uv^{M_L}$. We also note that the additional controls are not valid instruments in estimating (6) above, because they violate the exclusion restriction.

The results are reported in Table 8. All regressions include country fixed effects; columns 5–8 include in addition period fixed effects. In column 1 we see that although the sign of the coefficient to the ratio of the proxies for prices is correct, it is not precisely estimated. This may be a direct result of using proxies, rather than true prices.[24] In column 2 we include the three proxies separately; we estimate large and significant coefficients to $\Delta \ln uv^{M_H}$ and $\Delta \ln uv^{M_L}$. The coefficient to $\Delta \ln uv^{M_N}$ is not significant, which is what we expect. These results are robust to inclusion of period fixed effects.

In column 3 we add Δz, controls for sectoral composition and GDP per capita. Their effect is not precisely estimated and adding them hardly affect the coefficients to $\Delta \ln uv^{M_H}$ and $\Delta \ln uv^{M_L}$. Adding controls for FDI, financial development and IPR protection reduces the sample to 48 observations.[25] This increases the magnitude of the coefficients to $\Delta \ln uv^{M_H}$ and $\Delta \ln uv^{M_L}$, and IPR protection comes in with a statistically and economically significant coefficient.[26] However, when adding period dummies (column 8), the coefficient drops and becomes statistically insignificant.

The change in sample in columns 4 and 8 renders the coefficient to $\Delta \ln (H/L)$ large and statistically significant. In all other regressions (and others that are not reported here), the coefficient to $\Delta \ln (H/L)$ is small and insignificant. This supports our argument above, that the potential endogeneity of $\Delta \ln (H/L)$ does not bias the estimator of the coefficient to $\Delta \ln (M_H/M_L)$. In the appendix we show that the TSLS estimates are robust to dropping countries that export substantial amounts of capital goods.

We conclude that changes in prices are the most important factors determining the import ratio, which alone explain more than 50% of the within-country variation.

4 Complementarity of capital to skilled and unskilled labor

In this section we explain why the capital import ratio explains changes in the skill premium. Since Griliches (1969), capital is considered complementary to skilled labor. With some reservations about robustness, other studies generally confirm the capital-skill complementarity hypothesis.[27] However, these studies (including Griliches') investigate complementarity to aggregate measures

[24] Denote the proxy for p^{M_j} as uv^{Mj}, $j \in \{H, L\}$; then we can write $p^{M_j} = \theta_0^j + \theta_1^j uv^{Mj} + \varepsilon^j$. Taking the ratio $p^{M_H}/p^{M_L} = \left(\theta_0^H + \theta_1^H uv^{M_H} + \varepsilon^H\right) / \left(\theta_0^L + \theta_1^L uv^{M_L} + \varepsilon^L\right)$ we see that imprecise estimates may arise from the presence of nonzero θ_0^j terms, different θ_1^j terms, and if the variances of ε^j are large.

[25] We lose the Central African Republic, Madagascar, Honduras and Barbados.

[26] An increase in one standard deviation in IPR protection (which is 0.64) results in 0.35 standard deviations increase in the import ratio.

[27] See Fallon and Layard (1975), Bergstrom and Panas (1992), Duffy, Papageorgiou, and Perez-Sebastian (2004).

of capital; they do not consider the composition of capital. In this section we establish that R&D-intensive capital equipment is complementary to skilled labor, while less innovative capital equipment is complementary to unskilled labor.[28] To be precise, when we say that a type of capital is complementary to a class of workers, this is a relative statement. For example, R&D-intensive capital equipment is more complementary to skilled labor than to unskilled labor.

The estimation employs data from the EU KLEMS dataset (O'Mahony and Timmer (2009)), which includes mostly high income countries. The complementarity estimates in these data are relevant for developing countries, which import most of their capital equipment (as we establish above) from high income countries (as shown in Eaton and Kortum (2001)). The validity of this exercise for developing countries relies also on similarity in responses of relative demand for skill in different settings. We therefore estimate these responses using two definitions of skilled labor, one of which is more relevant for developing countries (more on this below).

We follow standard methodology and estimate a skilled labor share equation, e.g., as in Berman, Bound, and Griliches (1994). Assume a translog cost function where there are three inputs: Skilled and unskilled labor, and capital. If capital is a quasi-fixed factor, skilled and unskilled labor are variable factors, and production exhibits constant returns to scale, then cost minimization yields the following relationship

$$S = \alpha + \beta \ln\left(\frac{w_H}{w_L}\right) + \gamma \ln\left(\frac{K}{Y}\right) \ , \tag{7}$$

where S denotes the wage bill share of skilled labor, w_H and w_L are wages of skilled and unskilled labor, K is capital, and Y denotes value added.[29] The coefficient γ indicates the type and magnitude of complementarity. $\gamma > 0$ implies stronger complementarity to skilled labor, while $\gamma < 0$ implies stronger complementarity to unskilled labor.

We estimate versions of (7) as follows

$$S_{it} = \beta \ln\left(\frac{w_H}{w_L}\right)_{it} + \gamma_j \ln\left(\frac{K_j}{Y}\right)_{it} + \gamma_{-j} \ln\left(\frac{K_{-j}}{Y}\right)_{it} + \eta_i + \delta_t + \varepsilon_{it} \ , \tag{8}$$

where K_j is a type of capital and K_{-j} captures the sum of all other capital types. Here η_i and δ_t are country and year fixed effects, respectively. The fixed effects capture *inter alia* unobserved disembodied non-neutral technological change. We estimate (8) in an unbalanced panel of 14 countries in 1970–2005 using data from the EU-KLEMS dataset.

The EU-KLEMS dataset reports data on capital stocks for five distinct capital groups (j):

[28] This in itself can help explain the sensitivity of the results in Duffy, Papageorgiou, and Perez-Sebastian (2004): The composition and, hence, overall degree of complementarity of capital is not the same across countries in their panel.

[29] See appendix for the complete derivation.

Computing equipment, communication equipment, software capital, transport equipment, and machinery. First we estimate (8) separately for each capital group j. Then we aggregate into two groups: Information and communication equipment capital (ICT) and non-ICT; see Table 1. Finally, we also estimate (8) using the total capital stock.[30]

The EU-KLEMS disaggregates workers into three groups: High skilled, medium skilled, and low skilled. The definition of high skilled workers is consistent across countries, and implies a university-equivalent bachelors degree. The definitions of the other two groups vary somewhat across countries, but are consistent over time within a country. Medium skilled workers do not attain a university-equivalent bachelors degree, but complete high-school and possibly a non-university vocational degree; low skilled workers do not complete high school. We use two definitions of skill in the implementation of (8): High (narrow definition), and high + medium (broad definition). This facilitates two goals. First and foremost, the broad definition is more relevant for developing countries. Second, it allows checking the robustness of the complementarity results.[31] Wage bill shares for all three groups are given in the data directly. Wages are given by wage bills divided by hours worked. We follow standard methodology and estimate (8) by TSLS, instrumenting for the capital shares using their values in the previous period. Results are not sensitive to the number of lags included. We report standard errors using country level clustering.

The results in Table 9 show a clear pattern: On one hand, computing equipment, communication equipment, and software capital are complementary to skilled workers; on the other hand, transport equipment, and machinery are complementary to unskilled workers. Due to colinearity we cannot add separately all types of capital, but when ICT and non-ICT capital groups are included, we confirm the results for their subcomponents: ICT capital is complementary to skilled workers; non-ICT capital is complementary to unskilled workers. These results hold whether we use the narrow or the broad definition of skill. Since the year fixed effects add little explanatory power, fitting (8) without them yields virtually the same results. Taking changes in (7) and estimating the resulting equation by TSLS with country fixed effects—using lagged variables in changes as instruments—yields remarkably similar results.[32]

In the last column of Table 9 we also estimate that the aggregate capital stock is complementary to skilled labor. We find it comforting that we can replicate previous findings. This should not

[30] The sample for which capital data are available does not exhaust the entire EU-KLEMS sample. See appendix for the sample used in the complementarity estimation. In the appendix we also report shares of capital types in the aggregate captial stock, and changes thereof, for each country in the sample.

[31] Duffy, Papageorgiou, and Perez-Sebastian (2004) find the empirical evidence in favor of the capital-skill complementarity hypothesis at the aggregate level most convincing when skilled workers are defined broadly, as high + medium.

[32] These results are reported in the appendix.

be confused with the results in Section 3: The composition of the aggregate capital stock and investment in countries in the EU-KLEMS sample—which are mostly developed economies—is likely to be much more R&D intensive, with a higher share of ICT, relative to the sample of developing countries that we examine above.

We wish to estimate (8) using the nine groups by R&D intensity used above in Section 3. Unfortunately, the EU-KLEMS data on capital stocks are not classified according to ISIC. Based on EU-KLEMS documentation we feel comfortable to classify some ISIC capital types into broad ICT and non-ICT groups (see Table 1), but the mapping at the more disaggregated level is not obvious. Therefore we turn to OECD data.[33]

The OECD data report production Y, imports M, and exports X, by ISIC in 1970–2005. This allows estimating implied investment I for each of the nine capital groups

$$I_{g,t} = Y_{g,t} + M_{g,t} - X_{g,t} \ ,$$

where $g = 1, 2, ...9$ denotes R&D intensity rank. We then use the perpetual inventory method to estimate capital stocks

$$K_{g,t+1} = (1 - \delta_g) K_{g,t} + I_{g,t} \ .$$

Since capital stocks in the initial year are not available by type, we estimate

$$K_{g,0} = \frac{I_{g,0}}{\delta_g} \ .$$

Depreciation estimates by capital type δ_g are from Fraumeni (1997), and are based on U.S. data; these are the same depreciation rates that are used in the EU-KLEMS for construction of capital stocks by group (see O'Mahony and Timmer (2009)). We estimate (8) using these constructed capital stocks by R&D intensity, using the same estimator as above.[34]

Table 10 reports the complementarity estimation results, which largely confirm the results in Table 9 . Figure 2 summarizes the results in this section, based on Table 10 . The most R&D-intensive capital types (aircraft equipment, office, computing and accounting machinery, communication equipment) are complementary to skilled labor. Of the other six relatively less R&D-intensive capital types, four (electrical equipment excluding communication, non-electrical equipment, other transportation equipment, fabricated metal products) are complementary to unskilled labor. Motor vehicles and professional goods are not more complementary to either class of labor. It is for this reason that we do not include the latter two types of capital in M_L in the import composition esti-

[33] *StatsExtract* data available at: http://stats.oecd.org/

[34] The sample for which we calculate capital stocks using OECD data is reported in the appendix, where we also report shares of capital types in the aggregate captial stock, and changes thereof, for each country in the sample.

mation in Section 3 above. When we aggregate the top three R&D-intensive, skill-complementary capital groups (K_H), and the four unskilled-complementary capital groups (K_L), we confirm the results for their subcomponents: K_H is complementary to skilled workers; K_L is complementary to unskilled workers. The results are similar when we use the broad definition of skill (high + medium). When we aggregate to the three capital groups, we find once again that K_H is complementary to skilled workers; K_L is complementary to unskilled workers, broadly defined. The main difference is that motor vehicles, and hence K_N, are estimated to be complementary to skilled labor, broadly defined.

Overall, using several specifications and data sources, we find strong evidence for capital-skill complementarity for R&D-intensive, innovative capital types; we find that less innovative and relatively R&D-unintensive equipment is complementary to unskilled labor. This is the reason that the composition of capital imports (which stands in for investment), and not the overall quantity, affects the skill premium.

5 Trade liberalization and changes in the composition of capital imports

We argue above that an increase in the share of R&D-intensive, skill-complementary capital in total capital imports increases relative demand for skilled labor and therefore raises the skill premium. During 1983–1997, a period of trade liberalization in the sample of developing countries that we study, the share of M_H in our sample increases from 16.4% to 23.2% on average, commensurate with a drop in the share of M_L from 57.5% to 50.6%. However, this does not necessarily imply that trade liberalization increases the skill premium through this channel. This is a difficult question to answer, but in this section we provide some evidence that is consistent with this hypothesis.[35]

The mechanics of trade liberalization work through relative import prices of M_H versus M_L. In the framework of Section 2 this is represented by r_C/r_K. We decompose each capital import price r_j into four components: A "free on board" (FOB) price at the source r_j^*, ad valorem tariffs τ_j, specific (transportation) freight costs $\widetilde{f}_j$, and other distance-related ad valorem trade barriers d, so

[35] Alfaro and Hammel (2007) argue that in the same period stock market liberalizations are associated with increases in imports of capital equipment. This channel is complementary to liberalization in goods trade—both reduce the cost of purchasing capital equipment abroad. The question here is whether the effect of these reforms is greater on M_H versus M_L. Larrain (2013) argues that capital account liberalization in industrialized countries increased inequality by making available external funding for capital investment. He does not distinguish between different types of capital, but finds stronger effects in industries that exhibit stronger aggregate capital-skill complementarity and more external finance reliance. However, the estimated magnitudes are small, probably because the mechanism is not clearly identified. In contrast, we focus on the mechanism, in a set of less-developed countries.

that

$$\frac{r_C}{r_K} = \frac{\left(r_C^* + \widetilde{f}_C\right)(1+\tau_C)(1+d_C)}{\left(r_K^* + \widetilde{f}_K\right)(1+\tau_K)(1+d_K)} = \frac{r_C^*}{r_K^*} \cdot \frac{(1+f_C)(1+\tau_C)(1+d_C)}{(1+f_K)(1+\tau_K)(1+d_K)} , \tag{9}$$

where $f_j \equiv \widetilde{f}_j / r_j^*$ is the ad valorem equivalent freight cost. Although freight costs are usually denominated in specific (per unit, not per value) terms in the real world, a more meaningful way to analyze their impact on trade flows is to transform them into ad valorem terms (see Hummels and Skiba (2004) and Hummels (2007)). Most countries, with few exceptions, apply tariffs to the transport-inclusive CIF (cost, insurance and freight) price of a product, as in (9).[36] We add analysis for the few exceptions below. We first demonstrate that all three components f, τ and d fall more for M_H versus M_L (under a full set of countries, as well as specifically under our sample of developing economies in the latter case, where data enables testing that) – all of which reduce r_C/r_K, given r_C^*/r_K^*. We keep the exposition of results to a minimum; full statistical outputs are available upon request.

We start by demonstrating that on average, $1+\tau_C$ falls more than $1+\tau_K$. We use tariff data from the TRAINS dataset in 1988–2010, which gives us 2,632 observations over 169 countries.[37] We fit the following regression

$$\ln(1+\tau_{it}^j) = \delta_1 t + \delta_2 \left[I_{(j \in M_H)} \cdot t \right] + \delta_3 I_{(j \in M_H)} + \alpha_i + \varepsilon_{it} , \tag{10}$$

where i is a country, and $j \in \{M_H, M_L\}$ indicates that a product is either in the M_H or M_L capital import group, and α_i is a country fixed effect. We cluster standard errors by country. Developing countries are under-represented in TRAINS, but less so over time; therefore t denotes time since country i enters the dataset, which takes into account evolving coverage. We cluster standard errors by country.

The point estimate of δ_1 is -0.04 and the point estimate of δ_2 is -0.06, both statistically significant at the 1% level. Tariffs fall over time, but tariffs on M_H more so. Over the sample, $\delta_2 = -0.06$ translates into a relative reduction of 0.72. We also fit specifications similar to (10) with time dummies instead of linear time trends. Those regressions confirm the previous conclusion, but also illustrate that the drop is driven mostly by countries with long representation (large t).[38]

We now use data from Hummels (2007) on ad valorem freight costs for shipments into the U.S.

[36] There are 12 exceptions: Afghanistan, Australia, Botswana, Canada, Democratic Republic of the Congo, Lesotho, Namibia, New Zealand, Puerto Rico, South Africa, Swaziland, and the U.S., where tariffs are usually applied to the FOB (free on board) price. See http://export.customsinfo.com/ and http://export.gov/logistics/eg_main_018142.asp. We thank Robert Feenstra for this reference.

[37] TRAINS (Trade Analysis and Information System) data downloaded from http://wits.worldbank.org/wits/.

[38] Time dummies for M_H become increasingly large, negative and statistically significant after 7 years in the sample.

1983–2004, to demonstrate that transportation costs fall more for M_H than for M_L, but only for shipments by air (there are no statistical differences for shipments by sea). The share of trade by air is increasing, especially for M_H, so this is meaningful.[39] We fit the following regression

$$\ln(1+f_j) = \delta_1 t(j) + \delta_2 \left[I_{(j\in M_H)} \cdot t(j)\right] + \delta_3 I_{(j\in M_H)} + \gamma \ln(w/v)_j + \alpha_{s(j)} + \varepsilon_j \ , \tag{11}$$

where j is a shipment, $j \in \{M_H, M_L\}$ indicates that a product is either in the M_H or M_L capital import group, and $w/v =$ denotes the weight per dollar value of shipment. Here $\alpha_{s(j)}$ is a fixed effect for all shipments j imported from source s (which absorbs the effect of distance, *inter alia*), and $t(j)$ indicates that shipment j is observed in year t. In the estimation we weigh observations by shipment value and cluster standard errors by source country.

We first fit (11) using 220,568 observations on air shipments. The point estimate of δ_1 is -0.015 and the point estimate of δ_2 is -0.021, both statistically significant at the 1% level.[40] Air freight costs fall over time, but more so for tariffs on M_H. Over the sample, $\delta_2 = -0.021$ translates into a relative reduction of 0.44. We also fit specifications similar to (11) with time dummies instead of linear time trends. Year fixed effects absorb better global changes in fuel prices. Those regressions confirm the previous conclusion. However, we do not find evidence of a differential reduction in freight costs for shipments by sea.[41]

Finally, we demonstrate that distance trade resistance becomes higher for M_L relative to M_H. The data on freight costs pertain only to the U.S. imports, so the following exercise helps painting a more complete picture. We estimate gravity equations of the type

$$\begin{aligned} m^j_{sit} &= \beta_0 dist_{si} + \beta_1 [dist_{si} \cdot t] + \beta_2 \left[I_{(j=M_L)} \cdot dist_{si} \cdot t\right] + \beta_3 I_{(j=M_L)} \\ &\quad + \gamma' x_{si} + \chi_s + \eta_i + \delta_t + \varepsilon^j_{sit} \ , \end{aligned} \tag{12}$$

where m^j_{sit} are log imports from source s to importer i in time t, of capital type $j \in \{M_L, M_H\}$, $dist_{si}$ is log (great circle) distance between capital cities of s and i, χ_s, η_i and δ_t are exporter, importer and year fixed effects, respectively. Here x_{si} is a vector of standard bilateral trade resistance factors.[42] We estimate (12) by OLS, clustering standard errors by country-pair, using import data

[39] The share of air shipments for M_H doubles from 30% in 1983 to 61% in 2004. The shares of air shipments for M_N and M_L increase from 14% and 40% in 1983 to 18% and 43% in 2004, respectively.

[40] If we drop $\ln(w/v)$ the point estimates of δ_1 and δ_2 become -0.027 and -0.014, repsectively

[41] This result holds whether or not we include a control for containerization or not. See Hummels (2007) on the effect of containerization.

[42] The controls are taken from Helpman, Melitz, and Rubinstein (2008). These include indicators for: common language, same legal origin, common border, membership in a currency union, colonial ties, membership in the GATT or TWO, membership in a free trade agreement. In addition, we include the number of islands in the country pair and the number of landlocked countries in the country pair (0/1/2). See appendix for complete description of all variables.

in 1984–1999 (121,182 observations), for 160 countries.[43]

We estimate $\beta_2 = -0.006$ (highly statistically significant), which indicates that distance resistance increases for M_L relative to M_H. The result is identical when we restrict importers to the set of developing countries we study above in Section 3 (with no restriction on exporters). Over the sample this implies an increase of 9% in resistance to M_L relative to M_H. This can be compared to the 7% increase in the share of M_H at the expense of M_L in Table 3 for the sample of developing countries.

If we add to the specification (12) importer and exporter specific time trends, the estimate of β_2 falls somewhat to -0.004 (still highly statistically significant), which implies an increase of 6% in M_H relative to M_L over the sample. We also consider a specification with year-specific distance resistance, by replacing $\beta_1 \left[dist_{si} \cdot t\right] + \beta_2 \left[I_{(j=M_L)} \cdot dist_{si} \cdot t\right]$ with $\sum_t \beta_{1t} dist_{si} + \sum_t \beta_{2t} \left[I_{(j=M_L)} \cdot dist_{si}\right]$. The β_{2t} estimates become more negative over time, with most of the change occurring in 1987–1993. Results using sea shipping distance between ports from Feyrer (2009) are similar, with an estimate of $\beta_2 = -0.008$ in (12), and -0.006 in the specification with importer-specific time trends (both highly statistically significant).[44] All these results are invariant to restricting importers to the set of developing countries studied above (with no restriction on exporters).

Estimating (12) with a Heckman correction for sample selection or the nonlinear estimator of Helpman, Melitz, and Rubinstein (2008) is not possible without an excludable variable that varies over time, which is not available. However, below we estimate a version of (12) in a few cross sections using these estimators. While both estimators reduce the magnitude of distance resistance, the difference between distance resistance for M_L versus M_H remains large and similar in magnitude, regardless of the estimator we use.

We now address the few cases where tariffs are applied to FOB (free on board) prices. In those cases, (9) becomes

$$\frac{r_C}{r_K} = \frac{r_C^* \left(1 + \tau_C\right) + \widetilde{f}_C + \widetilde{d}_C}{r_K^* \left(1 + \tau_K\right) + \widetilde{f}_K + \widetilde{d}_K} = \frac{r_C^*}{r_K^*} \cdot \frac{1 + \tau_C + f_C + d_C}{1 + \tau_K + f_K + d_K} \ , \tag{13}$$

where $d_j \equiv \widetilde{d}_j / r_j^*$ is the ad valorem equivalent distance related cost, and f_j is defined above. Our findings above pertain to this case as well, but we can say something more here. If tariffs, transportation and distance-related costs are lower for R&D-intensive capital imports, then a blanket drop in tariffs at the same rate will also reduce r_C/r_K. To see this, write (13) as

$$\left.\frac{r_C}{r_K}\right|_{\Delta\tau=0} = \frac{r_C^*}{r_K^*} \cdot \frac{1 + \tau_C + \Delta\tau + f_C + d_C}{1 + \tau_K + \Delta\tau + f_K + d_K}$$

[43] See appendix for the list of countries in the sample.

[44] We thank James Feyrer for sharing his data with us.

and take the derivative with respect to $\Delta\tau$

$$\left.\frac{\partial}{\partial \Delta\tau}\frac{r_C}{r_K}\right|_{\Delta\tau=0} = \frac{r_C^*}{r_K^*}\cdot\frac{(\tau_K+f_K+d_K)-(\tau_C+f_C+d_C)}{(1+\tau_K+f_K+d_K)^2}\ .$$

This derivative is positive if $(\tau_K+f_K+d_K) > (\tau_C+f_C+d_C)$.[45] We now show that this is indeed the case. As above, we keep the exposition of results to a minimum; full statistical outputs are available upon request.

First, we show that not only does τ_C drop more than τ_K, it is smaller within countries throughout the sample. Using the same TRAINS tariff data and definitions above, we fit fixed effects regressions

$$\tau_{it}^j = \beta I_{(j\in M_H)} + \alpha_i + \delta_t + \varepsilon_{it}\ , \tag{14}$$

where α_i is a country fixed effect and δ_t is a year fixed effect. We cluster standard errors by country. We estimate $\beta = -2.46\%$ and highly statistically significant. Restricting the sample to the countries that apply tariffs to FOB prices gives $\beta = -3.42\%$. If we only consider the first year in the sample for each country (i.e. $t = 1$), then we find $\beta = -4.77\%$.

Second, we show that freight costs are lower for R&D-intensive capital. Using the same ad-valorem freight data used above to estimate (11), we fit regressions of the type

$$f_j = \beta I_{(j\in M_H)} + \gamma \ln(w/v)_j + \alpha_{s(j)} + \delta_{t(j)} + \varepsilon_j\ , \tag{15}$$

where $\alpha_{s(j)}$ is a source fixed effect for all shipments j imported from source s, and $\delta_{t(j)}$ is a time fixed effect for all shipments j that are observed in year t (which absorbs global changes in fuel prices). In the estimation we weigh observations by shipment value and cluster standard errors by source country. We estimate, with high precision, that $\beta = -16\%$ for air shipments and -7% for sea shipments.

Finally, we show that overall distance related trade resistance is higher for the less R&D-intensive capital imports. Using the same dataset used above to estimate (12), we fit gravity regressions of the type

$$m_{si} = \beta_0 dist_{si} + \beta_1\left[I_{(j=M_L)}\cdot dist_{si}\right] + \beta_2 I_{(j=M_L)} + \gamma' x_{si} + \chi_s + \eta_i + \varepsilon_{si}\ , \tag{16}$$

in several years. Since (16) has no time dimension, we can use, in addition to OLS, two estimators

[45] Contemplating an equal *percent point* drop in tariffs for both K and C is meaningful if the absolute difference between them before liberalization is not too large—which is what we find below. This is consistent with a larger drop in percent terms in $1+\tau_C$ versus $1+\tau_K$ found above, since we find $\tau_C < \tau_K$. Most of the differences that substantiate the inequality $(\tau_K+f_K+d_K) > (\tau_C+f_C+d_C)$ are driven by differences in f and d across capital import types.

that take into account zero trade flows between country pairs: The Heckman correction for sample selection (Heckit), and the nonlinear estimator of Helpman, Melitz, and Rubinstein (2008). Using all these estimators with great circle distances or the port distances from Feyrer (2009), we estimate β_1 between -0.26 and -0.32 (highly statistically significant). Using their estimator, the overall coefficient to log distance β_0 is lower versus OLS as in Helpman, Melitz, and Rubinstein (2008), but the differential β_1 is not. The results are even stronger when we restrict the sample to importers that apply tariffs to FOB prices, with no restriction on the source exporting countries, with an estimate of $\beta_1 = -0.45$.

To summarize this section, we document larger tariff cuts and larger reductions in freight costs for M_H versus M_L, and increases in distance resistance for M_L versus M_H. We also find that in levels, tariffs and freight costs are lower for M_H versus M_L, and that distance resistance for M_L is higher relative to M_H—which is relevant for the set countries that apply tariffs to FOB prices. We use three different data sets, each of which has advantages and shortcomings. But all the results imply that trade liberalization reduces r_C/r_K, which in turn increases inequality through the composition channel. We stress that this argument is valid for the average country, whereas on a case-by-case basis the effect of trade liberalization through the composition channel may be different.

6 Conclusion

Empirical investigations of episodes of trade liberalization usually do not find large effects on the skill premium. One reason is that these studies focus on traded final goods (e.g., Zhu and Trefler (2005), Verhoogen (2008), Bustos (2011)) or intermediate inputs (e.g. Feenstra and Hanson (1996), Amiti and Cameron (2012)), and typically focus on mechanisms that directly affect only the traded sector. In this paper we show that the composition of capital imports has strong explanatory power for changes in the skill premium in a sample of developing countries. In addition, we argue that trade liberalization can shift the distribution of capital imports in a way that increases the skill premium. Thus, we provide a novel explanation for the increase in the skill premium in developing countries that liberalized trade.

We find that when the composition of capital imports is more R&D intensive, the skill premium increases, whereas when it is less R&D intensive the skill premium falls. This is because R&D-intensive capital is complementary to skilled labor, whereas R&D-unintensive capital is complementary to unskilled labor. To our best knowledge, we are the first to argue that some types of capital are more complementary to unskilled workers. The composition of imports has a first order effect on the composition of capital stocks in developing countries, because they import most of their capital and produce little of it domestically. This is why the capital import ratio, a measure of import composition, has such strong explanatory power. We estimate that a one standard deviation increase in the import ratio increases the rate of change in the skill premium by more than one standard deviation.

We argue that trade liberalization has shifted the distribution of import composition towards more skill-complementary capital. First, tariff reductions and reductions in freight costs have been larger, on average, for skill-complementary equipment. In addition, distance resistance to imports of unskilled-complementary equipment increases relative to skill-complementary equipment. These shift the composition of capital imports towards skill-complementary equipment—and cause an increases in the skill premium.

Our results highlight the importance of the composition of imports, not just aggregate quantities. While we focus here on capital imports, we believe that the mechanism that we investigate—composition together with patterns of complementarities—can help explain results in other papers, e.g. Amiti and Cameron (2012). In addition, the importance of composition raises concerns for the validity of estimates of the contribution of capital imports to increases in the skill premium in quantitative trade models that have no role for composition. Since the composition of capital imports varies across countries, so does the effective complementarity of aggregate capital imports. Such quantitative analyses—in particular, Burstein, Cravino, and Vogel (2013) and Parro (2013)—can be modified to take into account capital import composition, together with the pattern of complementarities that we uncover. This can lead to a better understanding of the role of capital imports in affecting the distribution of the gains from trade.

Appendix

A Detailed descriptions of ISIC capital goods classifications

Capital goods are listed from highest to lowest R&D intensity based on Caselli and Wilson (2004) and ISIC in parentheses:

1. Aircraft equipment (3845): Aircraft and related parts.
2. Office, computing, and accounting machinery (3825): Computers, calculators, typewriters, and other office equipment (excluding photocopiers).
3. Communication equipment (3832): Semiconductors, wire and wireless telephone equipment, radio and TV sets, audio recording equipment, signaling equipment, radar equipment.
4. Professional goods (385): Measuring and controlling equipment, photographic and optical goods, and watches and clocks.
5. Electrical equipment, excluding communication equipment (383 *without* 3832): Electrical industrial machinery, electrical appliances, and other electrical apparatus.
6. Motor vehicles (3843): Automobiles and related parts (excludes industrial trucks and tractors).
7. Non-electrical equipment (382 *without* 3825): Engines and turbines, agricultural machinery (including tractors, excluding metal tools), metal and wood-working machinery, industrial trucks, military ordinance (including tanks).
8. Other transportation equipment (3842, 3844, 3849): Railroad equipment, motorcycles and bicycles, wagons and carts.
9. Fabricated metal products (381): Cutlery, hand tools, general hardware, metal furniture and fixtures, structural metal products.

B Data

B.1 Inequality regressions

Sample

The sample is an unbalanced panel covering 1983–1997 with varying time periods for each country, based on data availability for wage data, and builds on the sample of Zhu and Trefler (2005). All countries in this sample have real GDP per capita in 1980 below $14,000 in 1980 dollars. The sample is further restricted by data availability.

List of countries and periods: Algeria (1985–1989, 1990–1992), Argentina (1991–1993, 1993–1995), Barbados (1985–1989, 1990–1993, 1993–1995), Bolivia (1991–1994, 1994–1997), Central African Republic (1987–1989, 1991–1993, 1993–1997), Cyprus (1983–1986, 1986–1989, 1990–1993, 1993–1997), Honduras (1983–1987, 1990–1993, 1993–1997), Hong Kong (1983–1985, 1985–1989, 1991–1994, 1994–1997), India (1986–1989, 1990–1994, 1994–1997), South Korea (1983–1986, 1986–1989, 1991–1993, 1993–1997), Sri Lanka (1983–1985, 1985–1988, 1990–1993, 1993–1997), Madagascar (1983–1987, 1994–1995), Mauritius (1983–1985, 1985–1989, 1990–1993, 1993–1997), Mexico (1990–1993, 1993–1997), Philippines (1983–1986, 1986–1989, 1990–1994), Singapore (1985–1989, 1991–1993, 1993–1997), Thailand (1984–1986, 1991–1995), Trinidad and Tobago (1985–1988, 1990–1996), Uruguay (1985–1989, 1990–1993, 1993–1995), Venezuela (1984–1986, 1986–1989, 1990–1997).

Variable definitions

Change in the logarithm of skilled relative wage, $\Delta \ln \omega$*:* Defined as the wage ratio of manufacturing workers in non-production occupations (managers, professionals, technicians, and clerks) to manufacturing workers in production occupations (craft workers, operators, and laborers). Source: International Labour Organization.

Change in logarithm of relative supply of skill (skill abundance), $\Delta \ln (H/L)$*:* relative supply of skill is measured by the ratio of skilled to unskilled population. The skilled group is defined as those having at least secondary education. Source: Barro and Lee (2013).

Shift in export shares, Δz*:* Consider the area under the cumulative distribution function of export shares to OECD countries with 1980 real GDP per capita exceeds $14,000 (in 1980 dollars), where industries are ranked by their skill intensity. Δz is the difference in this area between the last and first year in each period. More formally, rank all industries for some country by skill intensity (based on the ratio of non-production workers to production workers) and normalize to 1. Define this rank as $r \in [0,1]$. The export share of each industry in time t is $x_t(r)$, where only exports to OECD countries with real GDP per capita in 1980 above $14,000 in 1980 dollars. $\Delta z_t = \int_0^1 \int_0^r x_t(s)\, dsdr - \int_0^1 \int_0^r x_{t-1}(s)\, dsdr$. Source: **Zhu and Trefler (2005).**

Industrial/Government/Services share: Value added share in GDP. Source: World Bank, World Development Indicators.

GDP, population: Source: Penn World Tables, Version 6.1 (Heston, Summers, and Aten (2012)).

Intellectual property rights protection index: This index characterizes strongly patent rights are protected. It is constructed using a coding scheme applied to national patent laws, examining five distinct categories. Source: Ginarte and Park (1997), updated by Park (2008).

Financial development: M3 money supply as a fraction of GDP. Source: World Bank, World Development Indicators.

Data from Feenstra, Lipsey, Deng, Ma, and Mo (2005)

Imports of R&D-intensive capital: Imports of R&D-intensive capital are averaged within each time interval. R&D-intensive capital is an aggregated group that includes the following ISICs: computing equipment (3825), communication equipment (3832) and aircraft equipment (3845).

Imports of R&D-unintensive capital: Imports of R&D-unintensive capital are averaged within each time interval. R&D-unintensive capital is an aggregated group that includes the following ISICs: fabricated metal products (381), non-electrical equipment (382 without 3825), electrical equipment (383 without 3832), and other transportation equipment (3842, 3844, 3849).

Imports of R&D-intermediate-intensive capital: Imports of R&D-intermediate-intensive capital are averaged within each time interval. R&D-intermediate-intensive capital is an aggregated group that includes the following ISICs: motor vehicles (3843), and professional goods (385).

Aggregate capital imports: Imports of aggregate capital are averaged within each time interval. Aggregate capital is an aggregated group that includes all nine capital groups.

The capital import ratio: The capital import ratio is defined as imports of R&D-intensive capital (averaged within each time interval) divided by R&D-unintensive capital (averaged within each time interval).

R&D-intensive , R&D-intermediate intensive, and R&D-unintensive instruments: The average change in the real unit price of each type of capital in the three main exporters that serve each country, calculated net of the effect of the country inspected. The unit price is calculated by dividing the average monetary value of exports (in the relevant type of capital) by the average quantity traded; this is then deflated to 1995 prices using specific deflators from the EU-KLEMS database (O'Mahony and Timmer (2009)). The three main exporters of each country are calculated for each country at the beginning of each investigated period. These unit values are then differenced within each period.

B.2 Complementarity estimation samples

Data on capital stocks from the EU KLEMS dataset are available for 14 countries: Australia (1970–2005), Austria (1976–2005), Czech Republic (1995–2005), Denmark (1970–2005), Finland (1970–2005), Germany (1970–2005), Italy (1970–2005), Japan (1970–2005), Netherlands (1970–2005), Portugal (1995–2005), Slovenia (1995–2005), Sweden (1993–2005), United Kingdom (1970–2005), United States (1970–2005).

The sample for which we are able to compute capital stocks according to the classification in Table 1 includes 17 countries: Austria (1995–2005), Belgium (1995–2005), Czech Republic (2001–2005), Finland (1980–2005), France (1978–2005), Germany (1980–2005), Hungary (1992–2005), Italy (1980–2005), Japan (1980–2005), Korea (1994–2005), Netherlands (1985–2005), Poland (1996–2005), Slovenia (1995–2005), Spain (1980–2005), Sweden (1980–2005), United Kingdom (1980–2005), United States (1980–2005).

B.3 Gravity estimation

Sample (1984–1999):

Afghanistan, Albania, Algeria, Angola, Argentina, Australia, Austria, Bahamas, Bahrain, Bangladesh, Barbados, Belgium-Lux, Belize, Benin, Bermuda, Bhutan, Bolivia, Brazil, Brunei, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Cayman Islds, Central Africa, Chad, Chile, China, Colombia, Comoros Islds., Congo, Costa Rica, Cote D'Ivoire, Cuba, Cyprus, Denmark, Djibouti, Dominican Rep., Ecuador, Egypt, El Salvador, Eq. Guinea, Ethiopia, Fiji, Finland, Fm. Czechoslovakia, Fm. USSR, Fm.Yugoslavia, France, French Guiana, Gabon, Gambia, Germany, Ghana, Greece, Greenland, Guadeloupe, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hong Kong, Hungary, Iceland, India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Kiribati, Korea DPR, Korea Rep., Kuwait, Laos, Lebanon, Liberia, Libya, Madagascar, Malawi, Malaysia, Maldives, Malta, Mauritania, Mauritius, Mexico, Mongolia, Morocco, Mozambique, Myanmar, Nepal, Netherlands, Neth. Antilles, New Caledonia, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Reunion, Romania, Rwanda, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, Solomon Islds., Somalia, South Africa, Spain, Sri Lanka, Mali, St. Kitts and Nevis, Sudan, Surinam, Sweden, Switzerland, Syria, Taiwan, Thailand, Togo, Trinidad-Tobago, Tunisia, Turkey, Turks and Caicos, Uganda, United Kingdom, United Arab Em., United Rep.Tanzania, United States, Uruguay, Venezuela, Vietnam, Yemen, Zambia, Zimbabwe.

Importing developing countries in restricted sample (exporters are unrestricted): Albania, Algeria, Argentina, Bahrain, Bangladesh, Barbados, Belize, Benin, Bhutan, Bolivia, Brazil, Bulgaria, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Chile, China, Colombia, Comoros, Congo, Costa Rica, Cote D'Ivoire, Cuba, Cyprus, Dominican Rep., Ecuador, Egypt, El Salvador, Fiji, Gabon, Gambia, Ghana, Greece, Guatemala, Guinea-Bissau, Guyana, Honduras, Hong Kong, Hungary, India, Indonesia, Iran, Ireland, Israel, Jamaica, Jordan, Kenya, Kiribati, Korea Rep., Liberia, Madagascar, Malawi, Malaysia, Mali, Malta, Mauritania, Mauritius, Mexico, Morocco, Mozambique, Nepal, New Caledonia, New Zealand, Nicaragua, Niger, Nigeria, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Portugal, Rwanda, St. Kitts and Nevis, Senegal, Seychelles, Sierra Leone, Singapore, South Africa, Sri Lanka, Sudan, Suriname, Syria, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uruguay, Venezuela, Zambia, Zimbabwe.

Variables

Disaggregated import flows by R&D intensity (based on Caselli and Wilson (2004) classification) were retrieved from Feenstra, Lipsey, Deng, Ma, and Mo (2005) trade database. All other data are from Helpman, Melitz, and Rubinstein (2008), except for port distance, which is from Feyrer (2009).

Distance: The distance in kilometers between importer and exporter capital cities.

Port Distance: Time in days between importer main port and exporter main port under the assumption that both the Panama and Suez canals are open, and assuming a ship speed of 20 knots and adding (or subtracting) the speed of the average ocean current along the path. In countries with several main ports, the one with lowest average overall distance is used.

Common Language: Indicator that equals one if importer and exporter have a common main language, and zero otherwise.

Common Border: Indicator that equals one if importer and exporter are neighbors that meet a common physical boundary, and zero otherwise.

Island: Indicator that equals one if both importer and exporter are islands, and zero otherwise.

Landlocked: Indicator that equals one if both exporter and importer have no coastline or direct access to sea, and zero otherwise.

Colonial Ties: Indicator that equals one if importer ever colonized exporter or vice versa, and zero otherwise.

Currency Union: Indicator that equals one if importer and exporter use the same currency or if within the country pair money was interchangeable at a 1:1 exchange rate for an extended period of time, and zero otherwise.

Legal System: Indicator that equals one if the importer and exporter share the same legal origin, and zero otherwise.

Religion Index: (% Protestants in country i × % Protestants in country j) + (% Catholics in country i × % Catholics in country j) + (% Muslims in country i × % Muslims in country j).

FTA: Indicator that equals one if exporter and importer belong to a common regional trade agreement, and zero otherwise.

WTO: Variable equals two if both importer and exporter belong to the GATT/WTO, equals one if only one belongs, and zero if none belong.

C Capital stocks and changes in relative demand for skill via changes in production patterns

We draw on the EU-KLEMS dataset. For each country and industry in the dataset we collect the following variables for 1983–1997 (the sample in the main analysis):

- The percent contribution to value added growth of two classes of capital—ICT (c_i) and non-ICT capital (n_i)
- The change in employment share of some industry i within a country (Δl_i)

In addition, we collect data on two measures of skill intensity in the initial year 1983: wage bill shares of skilled labor (s) and employment shares of skilled labor (e).

The predicted contributions of each capital type to change in the economy-wide skill intensity in production *through industry growth alone* are

$$\begin{aligned} C &= \sum_i c_i \Delta l_i s_i \\ N &= \sum_i n_i \Delta l_i s_i \ , \end{aligned}$$

for ICT and non-ICT capital, respectively. We divide C and N by aggregate skill intensity in the initial year, multiply by 100 and divide by the number of years over which they are computed—this gives us annualized percent point contributions to changes in skill intensity. We compute these both using s and using e. We compare C to N: This tells you which type of capital contributed to economy skill intensity more, via changes in production patterns.

The assumptions the underpin the validity of these calculations are constant returns to scale industries and that changes in the capital intensities do not alter skill intensity within industries over the period. The first assumption is easy to admit, while the second works only with specific production functions in certain environments (Leontief, or Cobb-Douglas with perfect competition). But what is important is that changes in the capital intensities do not alter the ranking of skill intensity across industries, which is evident in the data during this period.

D Derivations for analytical framework section

There are two types of capital—C and K (think computers and tractors, respectively)—and two types of labor—skilled H and unskilled L. The aggregate production function is given by

$$Q = \left[\delta X^{\frac{\sigma-1}{\sigma}} + (1-\delta)\, Y^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \ ,$$

where

$$\begin{aligned} X &= H^{\beta} C^{1-\beta} \\ Y &= L^{\beta} K^{1-\beta} \ , \end{aligned}$$

$\beta \in (0,1)$ and $\sigma > 1$.

Workers supply labor—either H or L— inelastically. Denote the wage of skilled labor by w_H and the wage of unskilled labor by w_L. Denote the price of capital as r_j for $j \in \{C, K\}$. Competitive factor markets imply that factors are paid the value of their marginal product:

$$\begin{aligned}
\frac{\partial Q}{\partial H} &= \frac{\sigma}{\sigma-1}\left[\cdot\right]^{\frac{\sigma}{\sigma-1}-1}\delta\frac{\sigma-1}{\sigma}X^{\frac{\sigma-1}{\sigma}-1}\beta\frac{X}{H} = \beta\delta Q^{\frac{1}{\sigma}}X^{\frac{\sigma-1}{\sigma}}H^{-1} = w_H \\
\frac{\partial Q}{\partial C} &= \frac{\sigma}{\sigma-1}\left[\cdot\right]^{\frac{\sigma}{\sigma-1}-1}\delta\frac{\sigma-1}{\sigma}X^{\frac{\sigma-1}{\sigma}-1}(1-\beta)\frac{X}{C} = (1-\beta)\,\delta Q^{\frac{1}{\sigma}}X^{\frac{\sigma-1}{\sigma}}C^{-1} = r_C \\
\frac{\partial Q}{\partial L} &= \frac{\sigma}{\sigma-1}\left[\cdot\right]^{\frac{\sigma}{\sigma-1}-1}(1-\delta)\frac{\sigma-1}{\sigma}Y^{\frac{\sigma-1}{\sigma}-1}\beta\frac{Y}{L} = \beta(1-\delta)\,Q^{\frac{1}{\sigma}}Y^{\frac{\sigma-1}{\sigma}}L^{-1} = w_L \\
\frac{\partial Q}{\partial K} &= \frac{\sigma}{\sigma-1}\left[\cdot\right]^{\frac{\sigma}{\sigma-1}-1}(1-\delta)\frac{\sigma-1}{\sigma}Y^{\frac{\sigma-1}{\sigma}-1}(1-\beta)\frac{Y}{K} = (1-\beta)(1-\delta)\,Q^{\frac{1}{\sigma}}Y^{\frac{\sigma-1}{\sigma}}K^{-1} = r_K \ .
\end{aligned}$$

The relative wage of skilled workers is

$$\begin{aligned}
\omega \equiv \frac{w_H}{w_L} &= \frac{\delta X^{\frac{\sigma-1}{\sigma}}H^{-1}}{(1-\delta)\,Y^{\frac{\sigma-1}{\sigma}}L^{-1}} = \frac{\delta}{1-\delta}\left(\frac{H^{\beta}C^{1-\beta}}{L^{\beta}K^{1-\beta}}\right)^{\frac{\sigma-1}{\sigma}}\left(\frac{H}{L}\right)^{-1} \\
&= \frac{\delta}{1-\delta}\left(\frac{H}{L}\right)^{-\frac{\sigma-\beta(\sigma-1)}{\sigma}}\left(\frac{C}{K}\right)^{\frac{(1-\beta)(\sigma-1)}{\sigma}} \ ,
\end{aligned}$$

as in the main text. In order to derive the expression for C/K we start with

$$\frac{r_C}{r_K} = \frac{\delta X^{\frac{\sigma-1}{\sigma}} C^{-1}}{(1-\delta) Y^{\frac{\sigma-1}{\sigma}} K^{-1}} = \frac{\delta}{1-\delta}\left(\frac{H^{\beta}C^{1-\beta}}{L^{\beta}K^{1-\beta}}\right)^{\frac{\sigma-1}{\sigma}}\left(\frac{C}{K}\right)^{-1}$$
$$= \frac{\delta}{1-\delta}\left(\frac{H}{L}\right)^{\frac{\beta(\sigma-1)}{\sigma}}\left(\frac{C}{K}\right)^{\frac{(1-\beta)(\sigma-1)-\sigma}{\sigma}} ,$$

which gives

$$\frac{C}{K} = \left(\frac{\delta}{1-\delta}\right)^{\frac{\sigma}{\sigma-(1-\beta)(\sigma-1)}}\left(\frac{H}{L}\right)^{\frac{\beta(\sigma-1)}{\sigma-(1-\beta)(\sigma-1)}}\left(\frac{r_C}{r_K}\right)^{-\frac{\sigma}{\sigma-(1-\beta)(\sigma-1)}} ,$$

as in the main text.

Here we show that $\sigma-(1-\beta)(\sigma-1)>0$ for $\beta\in(0,1)$ and $\sigma>0$, regardless of whether σ is greater than unity or not. For $\sigma>1$ we have a positive fraction, $(1-\beta)$, times a positive number smaller than σ, $(\sigma-1)$, which together give $(1-\beta)(\sigma-1)<\sigma$. When $\sigma<1$ the product $(1-\beta)(\sigma-1)<0$, but then deducting a negative number from a positive one remains positive.

E Derivation of complementarity equation

Suppose that capital is quasi-fixed and that there are two variable inputs: skilled and unskilled labor, h and l, respectively (this naturally extends to k variable inputs). So variable costs are given by $c = w_h \cdot h + w_l \cdot l$. If h and l are the argmin of costs, then c is the cost function. The logarithm of c can be approximated a translog cost function:

$$\ln(c) = \alpha_h \ln(w_h) + \alpha_l \ln(w_l) + \alpha_k \ln(k) + \alpha_y \ln(y) +$$
$$+\frac{1}{2}\left[\beta_{hh}\ln(w_h)^2 + \beta_{hl}\ln(w_h)\ln(w_l) + \beta_{lh}\ln(w_l)\ln(w_h) + \beta_{ll}\ln(w_l)^2 + \beta_{kk}\ln(k)^2 + \beta_{yy}\ln(y)^2\right]$$
$$+\gamma_{hk}\ln(w_h)\ln(k) + \gamma_{hy}\ln(w_h)\ln(y) + \gamma_{lk}\ln(w_l)\ln(k) + \gamma_{ly}\ln(w_l)\ln(y) + \gamma_{ky}\ln(k)\ln(y) ,$$

where k is capital and y is output. Symmetry implies $\beta_{hl} = \beta_{lh}$.

By Shephard's lemma, $\partial c/\partial w_h = h$, so that the cost share of skilled labor is

$$S \equiv \frac{w_h h}{c} = \frac{\partial \ln(c)}{\partial \ln(w_h)} = \frac{\partial c}{\partial w_h}\frac{w_h}{c} .$$

Using this in the translog we get

$$S = \alpha_h + \beta_{hh}\ln(w_h) + \beta_{hl}\ln(w_l) + \gamma_{hk}\ln(k) + \gamma_{hy}\ln(y) .$$

By linear homogeneity of cost with respect to prices, cost shares are homogenous of degree zero. Therefore $\beta_{hh} + \beta_{hl} = 0$. By linear homogeneity of the production function we have $\gamma_{hk} + \gamma_{hy} = 0$ (increasing all inputs by same factor increases output by same factor, but this should not affect the cost share). Using these two properties gives

$$S = \alpha + \beta \ln\left(\frac{w_h}{w_l}\right) + \gamma \ln\left(\frac{k}{y}\right) .$$

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Table 1: Capital Goods Classifications, R&D Intensity and Complementarity

A. ISIC Classifications

	R&D intensity rank	Complementarity	EU-KLEMS ICT classification
Aircraft equipment (3845)	1	Skilled labor	Non-ICT
Office, computing, and accounting machinery (3825)	2	Skilled labor	ICT
Communication equipment (3832)	3	Skilled labor	ICT
Professional goods (385)	4	-	Non-ICT
Electrical equipment, excluding communication (383 *without* 3832)	5	Unskilled labor	Non-ICT
Motor vehicles (3843)	6	-	Non-ICT
Non-electrical equipment (382 *without* 3825)	7	Unskilled labor	Non-ICT
Other transportation equipment (3842, 3844, 3849)	8	Unskilled labor	Non-ICT
Fabricated metal products (381)	9	Unskilled labor	Non-ICT

B. EU-KLEMS Classifications

	Complementarity	EU-KLEMS ICT classification
Computing equipment	Skilled labor	ICT
Communication equipment	Skilled labor	ICT
Software	Skilled labor	ICT
Transportation equipment	Unskilled labor	Non-ICT
Machinery	Unskilled labor	Non-ICT

Notes: R&D intensity rank by ISIC (numbers in parentheses) in 1980 is from Caselli and Wilson (2004). This ranking is based on their estimates of world R&D expenditures divided by world sales for each capital good; it is the same whether R&D flows or stocks (perpetual inventory method) are used. See Appendix for more detailed descriptions of ISIC capital classifications. We allocate EU-KLEMS ICT classifications to the ISIC classification based on the EU-KLEMS documentation. See O'Mahony and Timmer (2009) for documentation of the EU-KLEMS database. The degree of complementarity with skilled or unskilled labor is from authors' estimation; for details see Tables 9-10.

Table 2: Descriptive Statistics and Correlations, Import composition and Relative Wages

A. Descriptive Statistics

	Mean	Median	Std. Dev.	Min.	Max.
Δln(wH/wL)	-0.002	-0.0025	0.034	-0.093	0.071
Δln(H/L)	0.04	0.03	0.05	-0.12	0.15
Δz	0.0003	0	0.02	-0.07	0.05
ln(import ratio)	-0.74	-0.76	0.73	-2.36	0.68
ln(R&D intensive capital imports/GDP)	-5.08	-5.18	1.07	-6.92	-2.27
ln(R&D un-intensive capital imports/GDP)	-4.34	-4.26	0.73	-6.45	-2.55
ln(R&D intermediate-intensive capital imports/GDP)	-4.21	-4.4	0.85	-5.68	-2.08
ln(aggregate capital imports/GDP)	-3.28	-3.28	0.73	-4.49	-1.54
ln(R&D intensive capital imports)	6.74	6.55	2.07	2.59	10.31
ln(R&D un-intensive capital imports)	7.48	7.27	1.79	3.98	10.56
ln(R&D intermediate-intensive capital imports)	7.61	7.42	1.77	4.38	11.24
ln(aggregate capital imports)	7.93	7.58	1.86	4.26	10.99
Δln(uvH)	-0.00004	-0.0001	0.007	-0.012	0.014
Δln(uvM)	0.007	0.008	0.007	-0.015	0.019
Δln(uvL)	0.025	0.024	0.006	0.015	0.035
ln(FDI)	5.84	6.14	2.51	0.69	9.82
Δln(GDP/POP)	0.003	0.004	0.004	-0.009	0.01
Δgovernment share	0.004	0.002	0.02	-0.04	0.07
Δservices share	0.001	0.002	0.005	-0.01	0.01
Δfinancial development	0.01	0.007	0.02	-0.04	0.12
Δindustrial share	-0.001	-0.001	0.01	-0.02	-0.03
ΔIPR protection	0.02	0	0.04	-0.03	0.18

Notes: The sample includes 58 observations, covering 20 developing countries over the period of 1983-1997. Δln(wH/wL) is the change in the logarithm of skilled relative wage in manufacturing; Δln(H/L) is change in logarithm of aggregate relative supply of skill; Δz is shift in export shares to high income OECD countries; ln(import ratio) is the logarithm of the ratio of R&D-intensive capital imports to R&D-unintensive capital imports; ln(capital imports/GDP) is the logarithm of capital imports (for the R&D intensive, unintensive, and intermediate-intensive groups, as well as the overall aggregated group) normalized by GDP; Δln(uvH), Δln(uvM) and Δln(uvL) are the R&D-intensive , R&D-intermediate-intensive, and R&D-unintensive instruments, respectively. Ln(FDI) is the logarithm of the average US FDI (2005 prices). Δln(GDP/POP) is the change in the logarithm of GDP per capita. ΔIndustrial, ΔGovernment, ΔServices share are the changes in the logarithm of the sectoral value added shares in GDP. ΔFinancial-development is the change in the logarithm of M3 money supply as a fraction of GDP. ΔIPR-protection is the change in the Intellectual Property Rights Protection Index from Ginarte and Park (1997), updated by Park (2008). IPR-protection data are available every 5 years, so we linearly interpolate between observations within a country. All variables in levels are averages within change periods, while all variables in changes are annual changes. For further details on countries in the sample, data construction and sources, see Appendix.

Table 2--continued: Descriptive Statistics and Correlations, Import composition and Relative Wages

B. Correlations

	Δln(wH/wL)	Δln(H/L)	Δz	ln(MH/ML)	ln(MH/GDP)	ln(ML/GDP)	ln(MN/GDP)	ln(M/GDP)	Δln(uvH)	Δln(uvM)	Δln(uvL)	ln(FDI)	Δln(GDP/POP)	ΔGovernment	ΔServices	ΔFinancial	ΔIndustrial	ΔIPR
Δln(wH/wL)	1																	
Δln(H/L)	0.03	1																
Δz	0.35	0.01	1															
ln(import ratio)	0.5	0.01	0.09	1														
ln(MH/ML)	0.3	0.04	0.2	0.73	1													
ln(MH/GDP)	-0.06	0.05	0.21	0.07	0.74	1												
ln(ML/GDP)	0.22	-0.004	0.32	0.59	0.66	0.38	1											
ln(MN/GDP)	0.16	0.02	0.3	0.53	0.89	0.78	0.85	1										
ln(M/GDP)	-0.3	-0.15	-0.27	-0.63	-0.9	-0.69	-0.59	-0.82	1									
Δln(uvM)	-0.17	-0.07	-0.33	-0.47	-0.78	-0.67	-0.66	-0.82	0.88	1								
Δln(uvL)	-0.01	-0.13	-0.32	-0.19	-0.69	-0.82	-0.49	-0.81	0.72	0.8	1							
ln(FDI)	0.04	-0.14	0.32	0.3	0.5	0.4	0.43	0.51	-0.52	-0.62	-0.62	1						
Δln(GDP/POP)	0.4	0.14	0.04	0.48	0.43	0.15	0.33	0.33	-0.42	-0.32	-0.25	0.11	1					
ΔGovernment	-0.11	0.09	0.12	-0.08	0.06	0.17	0.05	0.10	-0.09	-0.01	-0.13	0.13	0.18	1				
ΔServices	0.17	0.09	0.10	0.13	0.06	-0.04	-0.03	-0.03	-0.04	0.04	0.06	0.01	0.28	0.36	1			
ΔFinancial	-0.05	0.05	-0.01	0.05	0.08	0.06	0.00	0.03	-0.12	-0.05	-0.01	0.15	0.14	0.32	0.26	1		
ΔIndustrial	-0.04	-0.03	-0.11	-0.11	0.08	0.23	-0.03	0.12	-0.16	-0.20	-0.24	0.02	-0.20	-0.10	-0.74	-0.19	1	
ΔIPR	0.17	0.05	0.36	0.07	0.14	0.13	0.27	0.20	-0.17	-0.20	-0.26	0.47	0.05	0.42	0.19	0.07	-0.06	1

Notes: The sample includes 58 observations, covering 20 developing countries over the period of 1983-1997. Δln(wH/wL) is change in the logarithm of skilled relative wage in manufacturing; Δln(H/L) is change in logarithm of aggregate relative supply of skill; Δz is shift in export shares to rich OECD countries; ln(import ratio) is the logarithm of the ratio of R&D-intensive capital imports to R&D-unintensive capital imports; ln(capital imports/GDP) is the logarithm of capital imports (for the R&D intensive, unintensive, and intermediate-intensive groups, as well as the overall aggregated group) normalized by GDP; Δln(uvH), Δln(uvM) and Δln(uvL) are the R&D-intensive , R&D-intermediate-intensive, and R&D-unintensive instruments, respectively. Ln(FDI) is the logarithm of the average US FDI (2005 prices). Δln(GDP/POP) is the change in the logarithm of GDP per capita. ΔIndustrial/Government/Services share are the changes in the logarithm of the sectoral value added shares in GDP. ΔFinancial-development is the change in the logarithm of M3 money supply as a fraction of GDP. ΔIPR-protection is the change in the Intellectual Property Rights Protection Index from Ginarte and Park (1997), updated by Park (2008). IPR-protection data are available every 5 years, so we linearly interpolate between observations within a country. All variables in levels are averages within change periods, while all variables in changes are annual changes. For further details on countries in the sample, data construction and sources, see Appendix.

Table 3: Capital Import Shares and Changes in Capital Import Shares

A. Average capital import shares

R&D intensity rank:		1	2	3	4	5	6	7	8	9	1+2+3	4+6	5+7+8+9
Capital type:		Aircraft equipment	Office, computing, and accounting machinery	Communication equipment	Professional goods	Electrical equipment, excluding communication	Motor vehicles	Non-electrical equipment	Other transportation equipment	Fabricated metal products	MH	MN	ML
Algeria	1984 - 1996	0.016	0.033	0.061	0.068	0.174	0.163	0.326	0.021	0.138	0.110	0.231	0.659
Argentina	1984 - 1997	0.027	0.100	0.123	0.079	0.163	0.204	0.238	0.017	0.049	0.251	0.282	0.467
Barbados	1983 - 1997	0.010	0.078	0.094	0.055	0.237	0.275	0.151	0.002	0.099	0.181	0.330	0.489
Bolivia	1983 - 1997	0.029	0.030	0.071	0.042	0.110	0.253	0.329	0.014	0.121	0.130	0.296	0.575
Central African Republic	1983 - 1993	0.011	0.042	0.067	0.038	0.102	0.422	0.197	0.034	0.087	0.120	0.460	0.420
Hong Kong	1983 - 1997	0.017	0.098	0.203	0.170	0.302	0.049	0.094	0.018	0.049	0.319	0.219	0.463
Cyprus	1983 - 1997	0.060	0.038	0.147	0.076	0.120	0.320	0.139	0.007	0.093	0.244	0.396	0.359
Honduras	1983 - 1996	0.045	0.034	0.083	0.047	0.131	0.245	0.293	0.011	0.111	0.162	0.292	0.546
India	1983 - 1997	0.086	0.061	0.061	0.126	0.178	0.061	0.361	0.024	0.042	0.208	0.187	0.605
Korea	1983 - 1997	0.057	0.074	0.078	0.116	0.313	0.036	0.281	0.006	0.038	0.210	0.152	0.638
Madagascar	1983 - 1986	0.015	0.020	0.035	0.067	0.086	0.270	0.405	0.021	0.081	0.069	0.337	0.593
Mauritius	1983 - 1997	0.133	0.034	0.109	0.140	0.098	0.163	0.229	0.014	0.081	0.276	0.303	0.421
Mexico	1984 - 1997	0.018	0.075	0.104	0.070	0.251	0.172	0.219	0.011	0.080	0.197	0.242	0.561
Philippines	1983 - 1997	0.055	0.058	0.082	0.049	0.372	0.105	0.217	0.014	0.048	0.195	0.154	0.651
Singapore	1983 - 1997	0.049	0.148	0.147	0.079	0.353	0.037	0.135	0.007	0.045	0.344	0.116	0.540
Sri Lanka	1983 - 1997	0.058	0.038	0.112	0.052	0.137	0.226	0.237	0.062	0.078	0.208	0.278	0.514
Thailand	1984 - 1996	0.036	0.095	0.081	0.058	0.251	0.147	0.260	0.014	0.057	0.212	0.205	0.582
Trinidad and Tobago	1983 - 1995	0.069	0.049	0.062	0.060	0.115	0.198	0.347	0.002	0.098	0.180	0.258	0.561
Uruguay	1983 - 1997	0.009	0.063	0.133	0.069	0.132	0.324	0.210	0.013	0.046	0.206	0.394	0.400
Venezuela	1983 - 1997	0.010	0.058	0.078	0.068	0.132	0.272	0.313	0.017	0.052	0.145	0.340	0.515
Average		0.041	0.061	0.096	0.077	0.188	0.197	0.249	0.017	0.075	0.198	0.274	0.528

B. Changes in capital import shares

R&D intensity rank:		1	2	3	4	5	6	7	8	9	1+2+3	4+6	5+7+8+9
Capital type:		Aircraft equipment	Office, computing, and accounting machinery	Communication equipment	Professional goods	Electrical equipment, excluding communication	Motor vehicles	Non-electrical equipment	Other transportation equipment	Fabricated metal products	MH	MN	ML
Algeria	1984 - 1996	-0.015	0.040	0.029	0.024	0.063	0.043	-0.031	0.024	-0.177	0.054	0.066	-0.120
Argentina	1984 - 1997	0.009	-0.035	0.040	-0.051	-0.034	0.150	-0.053	-0.040	0.015	0.014	0.099	-0.113
Barbados	1983 - 1997	0.068	0.009	0.026	-0.020	-0.223	0.181	0.000	-0.003	-0.036	0.103	0.161	-0.263
Bolivia	1983 - 1997	-0.003	0.025	0.146	-0.009	0.046	0.101	-0.118	-0.004	-0.185	0.168	0.092	-0.260
Central African Republic	1983 - 1993	-0.002	0.076	0.006	-0.008	0.099	-0.026	-0.026	-0.060	-0.059	0.080	-0.034	-0.046
Hong Kong	1983 - 1997	-0.010	0.081	0.096	-0.127	0.026	0.003	-0.007	-0.011	-0.051	0.167	-0.124	-0.043
Cyprus	1983 - 1997	0.014	0.049	-0.064	-0.035	-0.002	0.053	-0.001	-0.005	-0.009	-0.001	0.018	-0.017
Honduras	1983 - 1996	-0.015	0.029	0.029	-0.025	0.029	0.097	-0.082	-0.009	-0.053	0.043	0.072	-0.115
India	1983 - 1997	-0.047	0.073	-0.006	-0.016	0.074	0.013	-0.075	-0.015	-0.001	0.020	-0.003	-0.017
Korea	1983 - 1997	-0.013	0.021	-0.057	0.023	0.141	-0.027	-0.066	-0.014	-0.009	-0.049	-0.004	0.052
Madagascar	1983 - 1986	-0.006	0.008	0.023	-0.033	-0.090	0.015	0.133	-0.009	-0.040	0.024	-0.018	-0.007
Mauritius	1983 - 1997	0.341	0.041	-0.024	-0.118	-0.036	0.034	-0.183	-0.002	-0.053	0.358	-0.085	-0.274
Mexico	1984 - 1997	-0.007	-0.004	0.006	-0.014	0.128	-0.043	-0.111	-0.007	0.052	-0.005	-0.057	0.062
Philippines	1983 - 1997	-0.013	0.104	0.037	-0.023	0.082	-0.039	-0.097	-0.014	-0.038	0.129	-0.062	-0.067
Singapore	1983 - 1997	-0.038	0.159	-0.020	-0.023	0.073	-0.045	-0.063	0.000	-0.043	0.101	-0.067	-0.033
Sri Lanka	1983 - 1997	-0.023	0.103	0.020	-0.005	-0.008	-0.046	0.037	0.007	-0.085	0.100	-0.051	-0.049
Thailand	1984 - 1996	0.002	0.077	-0.042	-0.027	0.167	-0.041	-0.138	-0.010	0.012	0.038	-0.068	0.030
Trinidad and Tobago	1983 - 1995	-0.003	0.029	-0.033	-0.024	-0.013	-0.059	0.210	-0.006	-0.101	-0.007	-0.083	0.090
Uruguay	1983 - 1997	0.007	0.042	-0.056	-0.051	0.020	0.182	-0.125	0.011	-0.027	-0.008	0.130	-0.122
Venezuela	1983 - 1997	-0.041	0.035	0.048	-0.007	0.026	0.028	-0.094	-0.013	0.019	0.042	0.020	-0.062
Average		0.010	0.048	0.010	-0.029	0.028	0.029	-0.044	-0.009	-0.043	0.068	0.000	-0.069

Notes: In Panel A import capital shares are computed as shares in total capital imports and averaged over all available years. In Panel B changes in capital import shares are computed as the share in the last year minus the share in the first year. Samples are noted next to each country. Averages over all countries are reported below country data. Import data are from Feenstra et al. (2005).

Table 4: Import and Net Import Shares in Implied Investment

	H		N		L		All	
	Imports	Net Imports	Imports	Net Imports	Imports	Net Imports	Imports	Net Imports
Algeria	-	-	-	-	-	-	-	-
Argentina	0.62	0.59	0.17	0.09	0.32	0.27	0.22	0.16
Barbados	1.47	1	0.95	0.81	0.58	0.20	0.74	0.46
Bolivia	1.02	1	0.92	0.90	0.84	0.83	0.89	0.87
Central African Republic	1.01	1	0.98	0.95	0.90	0.89	0.84	0.83
Hong Kong	1.75	1	1.12	0.40	0.76	0.42	1.02	0.48
Cyprus	1.15	1	0.99	0.93	0.54	0.47	0.78	0.70
Honduras	1.01	1	0.92	0.92	0.56	0.54	0.69	0.67
India	1.46	1	0.07	0.04	0.11	0.05	0.12	0.07
Korea	0.18	-0.12	0.14	-0.02	0.29	0.03	0.25	-0.01
Madagascar	1.08	1	0.86	0.85	0.72	0.71	0.78	0.77
Mauritius	1.05	1	0.94	0.47	0.68	0.65	0.83	0.67
Mexico	-0.96	2.02	0.42	-0.33	1.37	0.44	0.96	-0.25
Philippines	1.21	-0.28	0.53	0.25	2.15	0.27	1.07	-0.02
Singapore	0.78	-0.20	0.90	0.61	1.14	0.50	0.93	0.20
Sri Lanka	1.20	1	0.83	0.82	0.82	0.75	0.88	0.81
Thailand	0.92	-0.89	0.41	0.33	0.51	0.32	0.58	0.31
Trinidad and Tobago	1.06	1	0.68	0.67	0.59	0.57	0.67	0.64
Uruguay	1.05	1	0.63	0.44	0.41	0.36	0.55	0.45
Venezuela	1.03	1	0.35	0.28	0.37	0.34	0.40	0.35
Average	0.95	0.74	0.67	0.50	0.72	0.45	0.69	0.43

Notes: This table reports average shares of imports and net imports (= imports - exports) in implied investment for three types of capital goods and for their sum, where implied investment = output + imports - exports. Capital types are: H = high R&D intensity (ranks 1, 2, 3), skill-complementary; N = medium R&D intensity (ranks 4, 6), neutral skill-complementarity; L = low R&D intensity (ranks 5, 7, 8, 9), unskilled labor-complementary; ALL = H + N + L. Import data correspond to this classification exactly; output data do not distinguish aircraft equipment from other transportation equipment, which are included in group L. Output data are from UNIDO and trade data are from Feenstra et al. (2005). The sample is 1983-1997, but due to UNIDO data limitations the sample is not full for all countries. There are only two observations for H and L imports for the Philippines in 1996-1997; there are only two observations for H imports for Thailand in 1996-1997; there are no output data for Algeria.

Table 5: Correlation between Capital Imports and Implied Investment

Investment type:	H		N		L		ALL	
	Imp.	Net Imp.	Imp.	Net Imp.	Imp.	Net Imp.	Imp.	Net Imp.
Algeria	-	-	-	-	-	-	-	-
Argentina	0.86	0.85	0.93	0.96	0.67	0.73	0.95	0.97
Barbados	0.93	1	0.97	0.98	-0.02	0.70	0.74	0.89
Bolivia	1	1	1	1	0.99	0.99	1	1
Central African Republic	1	1	0.97	0.97	1	1	1	1
Hong Kong	1	1	0.95	0.99	0.99	0.98	1	0.99
Cyprus	1	1	1	1	0.99	0.97	1	0.99
Honduras	1	1	1	1	0.97	0.97	0.99	0.99
India	0.91	1	0.96	0.06	0.68	-0.14	0.86	0.11
Korea	0.99	-0.79	0.99	-0.57	0.98	-0.86	0.99	-0.75
Madagascar	0.87	1	0.94	0.93	0.95	0.94	0.94	0.93
Mauritius	1	1	0.97	0.93	0.99	0.99	1	0.99
Mexico	0.32	0.84	0.86	-0.19	0.89	0.95	0.92	0.26
Philippines	-	-	0.99	0.97	-	-	0.96	0.46
Singapore	1	-0.95	0.93	0.95	1	1	1	0.98
Sri Lanka	0.96	1	0.99	0.99	0.99	0.98	1	0.99
Thailand	-	-	0.93	0.93	0.90	0.94	0.95	0.78
Trinidad and Tobago	1	1	0.97	0.97	0.88	0.90	0.94	0.95
Uruguay	1	1	0.72	0.83	0.94	0.94	0.92	0.93
Venezuela	1	1	0.85	0.80	0.69	0.77	0.84	0.85

Notes: This table reports pairwise correlation coefficients between implied investment and imports of capital goods or net imports of capital goods for three types of capital goods and for their sum. Implied investment = output + imports - exports. Net imports = imports - exports. Capital types are: H = high R&D intensity (ranks 1, 2, 3), skill-complementary; N = medium R&D intensity (ranks 4, 6), neutral skill-complementarity; L = low R&D intensity (ranks 5, 7, 8, 9), unskilled labor-complementary; ALL = H + N + L. Import data correspond to this classification exactly; output data do not distinguish aircraft equipment from other transportation equipment, which are included in group L. Output data are from UNIDO and trade data are from Feenstra et al. (2005). The sample is 1983-1997, but due to UNIDO data limitations the sample is not full for all countries. There are only two observations for H and L imports for the Philippines in 1996-1997; there are only two observations for H imports for Thailand in 1996-1997; there are no output data for Algeria; no correlations are reported for those cases.

Table 6: Capital Import Composition and the Skill Premium, 1983-1997, OLS

	Dependent variable: Δln(wH/wL)											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Δln(H/L)	0.059	0.006	0.094	0.111	0.101	0.109	0.101*	0.045	0.030	-0.047	0.067	0.074
	(0.070)	(0.130)	(0.076)	(0.081)	(0.066)	(0.075)	(0.057)	(0.054)	(0.072)	(0.118)	(0.078)	(0.082)
ln(MH/ML)	0.053***		0.055***	0.067***			0.049***	0.044***	0.037***		0.055***	
	(0.011)		(0.010)	(0.012)			(0.008)	(0.011)	(0.008)		(0.014)	
ln(M/GDP)		0.009	0.015*	0.013			0.008	0.005	0.005			
		(0.012)	(0.008)	(0.011)			(0.008)	(0.008)	(0.006)			
ln(MH/GDP)					0.057***	0.069***						0.058***
					(0.010)	(0.012)						(0.015)
ln(ML/GDP)					-0.051***	-0.062***						-0.049***
					(0.009)	(0.011)						(0.013)
ln(MN/GDP)					0.012*	0.010						
					(0.006)	(0.009)						
<u>Control variables</u>												
Δz							0.511***	0.595***	0.576**			
							(0.164)	(0.203)	(0.231)			
								<u>Changes</u>	<u>Levels</u>			
ln(FDI)								-0.531*	-0.001			
								(0.269)	(0.012)			
ln(GDP/POP)								2.122	-0.025			
								(2.004)	(0.026)			
ln(industrial share)								-0.413	-0.062			
								(0.574)	(0.109)			
ln(government share)								-0.106	-0.041			
								(0.194)	(0.031)			
ln(services share)								-0.711	0.008			
								(0.999)	(0.143)			
ln(financial development)								0.017	0.014			
								(0.175)	(0.016)			
IPR protection index								0.128*	0.014			
								(0.061)	(0.020)			
<u>Instruments</u>												
Δln(uvH)										-3.997***	-0.055	0.371
										(1.204)	(1.327)	(1.377)
Δln(uvL)										2.488**	-0.532	0.212
										(0.927)	(1.199)	(1.330)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period FE	No	No	No	Yes	No	Yes	No	No	No	No	No	No
Observations	58	58	58	58	58	58	58	48	48	58	58	58
R-squared	0.44	0.02	0.48	0.6	0.51	0.62	0.61	0.66	0.64	0.22	0.45	0.46

Notes: OLS estimates. 20 countries in all specifications. Standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is Δln(wH/wL), change in the logarithm of skilled relative wage. Main explanatory variables: Δln(H/L) is the change in logarithm of relative supply of skill; ln(MH/ML) is the logarithm of the ratio of R&D-intensive capital imports to R&D-unintensive capital imports; ln(M/GDP) is the logarithm of aggregate capital imports divided by GDP, and similarly for MH, ML and MN, where MN is intermediate-intensive capital imports. Control variables: Δz is shift in export shares as in Zhu and Trefler (2005); ln(FDI) is the logarithm of US foreign direct investment position in the target country in 2005 prices. ln(GDP/POP) is the logarithm of real GDP per capita; industrial, government and services shares are the sectoral value added shares in GDP (all in logarithms); ln(financial development) is the logarithm of M3 money supply divided by GDP; the IPR protection index is the Intellectual Property Rights Protection Index from Ginarte and Park (1997), updated by Park (2008). IPR-protection data are available every 5 years, so we linearly interpolate between observations within a country. Δln(uvH) and Δln(uvL) are the instruments used for R&D-intensive and R&D-unintensive captial, respectively (these are used in Table 7). All variables in levels are averages within periods, while all variables in changes are annual changes. See Appendix for further details on countries in the sample, data construction and sources.

Table 7: Capital Import Composition and the Skill Premium, 1983-1997, TSLS

A. Two stage least squares estimates

	Dependent variable: Δln(wH/wL)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δln(H/L)	0.080	0.099	0.104	0.095	0.092	0.105	0.001
	(0.076)	(0.076)	(0.065)	(0.074)	(0.058)	(0.083)	(0.065)
ln(MH/ML)	0.056***	0.062***			0.050***	0.065**	0.033***
	(0.014)	(0.014)			(0.011)	(0.026)	(0.010)
ln(M/GDP)	0.008	0.009			0.002	0.015	-0.002
	(0.011)	(0.013)			(0.010)	(0.015)	(0.008)
ln(MH/GDP)			0.061***	0.062***			
			(0.015)	(0.014)			
ln(ML/GDP)			-0.059***	-0.056***			
			(0.014)	(0.015)			
ln(MN/GDP)			0.012**	0.001			
			(0.005)	(0.015)			
Control variables							
Δz					0.528***	0.368	0.667***
					(0.162)	(0.364)	(0.247)
						Changes	Levels
ln(FDI)						-0.467**	-0.001
						(0.195)	(0.011)
ln(GDP/POP)						1.533	-0.029
						(2.000)	(0.024)
ln(industrial share)						-1.200	-0.059
						(1.073)	(0.100)
ln(government share)						-0.021	-0.041
						(0.233)	(0.028)
ln(services share)						-2.071	-0.003
						(1.848)	(0.134)
ln(financial development)						0.051	0.016
						(0.179)	(0.016)
IPR protection index						0.157***	0.018
						(0.057)	(0.018)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period FE	No	Yes	No	Yes	No	No	No
Observations	58	58	58	58	58	47	47

Notes: TSLS estimates. 20 countries in specifications 1-5; 17 countries in specifications 6-7 . Standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is Δln(wH/wL), change in the logarithm of skilled relative wage. Main explanatory variables: Δln(H/L) is the change in logarithm of relative supply of skill; ln(MH/ML) is the logarithm of the ratio of R&D-intensive capital imports to R&D-unintensive capital imports; ln(M/GDP) is the logarithm of aggregate capital imports divided by GDP, and similarly for MH, ML and MN, where MN is intermediate-intensive capital imports. Control variables: Δz is shift in export shares as in Zhu and Trefler (2005); ln(FDI) is the logarithm of US foreign direct investment position in the target country in 2005 prices. ln(GDP/POP) is the logarithm of real GDP per capita; industrial, government and services shares are the sectoral value added shares in GDP (all in logarithms); ln(financial development) is the logarithm of M3 money supply divided by GDP; the IPR protection index is the Intellectual Property Rights Protection Index from Ginarte and Park (1997), updated by Park (2008). IPR-protection data are available every 5 years, so we linearly interpolate between observations within a country. The excluded instruments for specifications 1-2 and 5-7 are Δln(uvH) and Δln(uvL), which are unit prices for R&D-intensive and R&D-unintensive captial, respectively; the excluded instrument set for specifications 3-4 include in addition Δln(uvN), which is the unit price for medium R&D-intensity captial imports (see Appendix for exact definition). All variables in levels are averages within periods, while all variables in changes are annual changes. See Appendix for further details on countries in the sample, data construction and sources.

Table 7--continued: Capital Import Composition and the Skill Premium, 1983-1997, TSLS

B. First stage results

Specification in Panel A:	(1)	(1)	(2)	(2)	(3)	(3)	(3)	(4)	(4)	(4)	(5)	(5)	(6)	(6)	(7)	(7)
Endogenous Dep. Var.:	ln(MH/ML)	ln(M/GDP)	ln(MH/ML)	ln(M/GDP)	ln(MH/GDP)	ln(ML/GDP)	ln(MN/GDP)	ln(MH/GDP)	ln(ML/GDP)	ln(MN/GDP)	ln(MH/ML)	ln(M/GDP)	ln(MH/ML)	ln(M/GDP)	ln(MH/ML)	ln(M/GDP)
Δln(uvH)	-71.4***	-2.2	-70.3***	-9.6	-106.9***	-31.9*	80.1**	-92.9***	-19.5	39.5	-69.4***	0.3	-55.2**	6.6	-85.4***	14.9
	(19.1)	(18.5)	(16.2)	(16.8)	(15.7)	(16.3)	(38.1)	(18.9)	(19.0)	(30.9)	(19.3)	(17.3)	(20.2)	(25.3)	(24.4)	(19.4)
Δln(uvL)	54.7***	-70.8***	54.0***	-69.1***	-55.4***	-107.3***	-14.6	-49.4***	-101.6***	-25.8	55.1***	-70.2***	62.5***	-84.0***	61.9***	-88.6***
	(11.6)	(15.3)	(10.2)	(13.0)	(10.5)	(11.2)	(28.0)	(11.6)	(11.1)	(24.4)	(12.1)	(14.9)	(14.1)	(17.4)	(16.7)	(15.8)
Δln(uvM)					27.3***	19.1	-101.0***	10.9	5.1	-56.0***						
					(7.8)	(11.7)	(23.9)	(14.8)	(15.0)	(19.3)						
Shea partial R-squared	0.39	0.36	0.47	0.43	0.36	0.37	0.24	0.46	0.34	0.15	0.37	0.34	0.20	0.23	0.40	0.43
Partial R-squared	0.51	0.48	0.56	0.51	0.58	0.63	0.36	0.56	0.66	0.26	0.51	0.48	0.50	0.58	0.62	0.67
F-stat for weak instruments	19.67	12.31	29.34	19.79	36.35	43.05	7.42	14.72	30.79	6.38	16.78	12.42	10.47	12.93	8.40	20.76

Notes: TSLS estimates. 20 countries in specifications 1-5; 17 countries in specifications 6-7 . Standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is Δln(wH/wL), change in the logarithm of skilled relative wage. Main explanatory variables: Δln(H/L) is the change in logarithm of relative supply of skill; ln(MH/ML) is the logarithm of the ratio of R&D-intensive capital imports to R&D-unintensive capital imports; ln(M/GDP) is the logarithm of aggregate capital imports divided by GDP, and similarly for MH, ML and MN, where MN is intermediate-intensive capital imports. Control variables: Δz is shift in export shares as in Zhu and Trefler (2005); ln(FDI) is the logarithm of US foreign direct investment position in the target country in 2005 prices. ln(GDP/POP) is the logarithm of real GDP per capita; industrial, government and services shares are the sectoral value added shares in GDP (all in logarithms); ln(financial development) is the logarithm of M3 money supply divided by GDP; the IPR protection index is the Intellectual Property Rights Protection Index from Ginarte and Park (1997), updated by Park (2008). IPR-protection data are available every 5 years, so we linearly interpolate between observations within a country. The excluded instruments for specifications 1-2 and 5-7 are Δln(uvH) and Δln(uvL), which are unit prices for R&D-intensive and R&D-unintensive captial, respectively; the excluded instrument set for specifications 3-4 include in addition Δln(uvN), which is the unit price for medium R&D-intensity captial imports (see Appendix for exact definition). All variables in levels are averages within periods, while all variables in changes are annual changes. See Appendix for further details on countries in the sample, data construction and sources.

Table 8: Determinants of the Import Ratio, 1983-1997

	Dependent variable: ln(MH/ML)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δln(H/L)	-1.64	-2.11	-2.07	-3.65***	-1.55	-1.74	-1.81	-3.19***
	(1.52)	(1.40)	(1.42)	(0.81)	(1.47)	(1.28)	(1.11)	(0.96)
Δln(uvH/uvL)	-0.95*				-0.83			
	(0.52)				(0.49)			
Δln(uvH)		-74.94***	-79.06***	-94.31***		-73.35***	-69.37***	-77.84***
		(19.49)	(19.56)	(27.29)		(17.48)	(16.05)	(21.05)
Δln(uvL)		51.90***	48.49***	56.21***		52.19***	50.81***	69.34***
		(11.25)	(14.66)	(15.43)		(10.48)	(11.54)	(7.63)
Δln(uvM)		8.13	19.40	20.49		5.74	8.26	3.87
		(6.42)	(17.81)	(16.90)		(9.87)	(13.67)	(21.91)
Δz			3.49	3.94			4.53**	6.13**
			(2.13)	(2.39)			(1.73)	(2.25)
ln(GDP/POP)			0.09	-0.22			-0.04	-0.54
			(0.25)	(0.22)			(0.21)	(0.31)
Industrial share			0.31	-0.42			1.12**	0.20
			(0.55)	(1.26)			(0.50)	(1.14)
Government share			0.23	0.20*			0.05	0.25
			(0.16)	(0.12)			(0.18)	(0.17)
Services share			-0.04	-0.45			1.51	0.76
			(1.28)	(1.72)			(0.93)	(2.00)
ln(FDI)				0.03				-0.03
				(0.15)				(0.16)
Financial development				0.26				0.28
				(0.25)				(0.30)
IPR-protection				0.40***				0.12
				(0.14)				(0.13)
R-squared, within	0.18	0.53	0.57	0.73	0.30	0.65	0.71	0.81
Observations	58	58	58	48	58	58	58	48
No. of countries	20	20	20	17	20	20	20	17
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period FE	No	No	No	No	Yes	Yes	Yes	Yes

Notes: OLS estimates. Robust standard errors, clustered by country, *** p<0.01, ** p<0.05, * p<0.1. ln(MH/ML) is the logarithm of the ratio of R&D-intensive capital imports to R&D-unintensive capital imports; Δln(H/L) is change in logarithm of relative supply of skill; Δln(uvH), Δln(uvM) and Δln(uvL) are the R&D-intensive , R&D-intermediate-intensive, and R&D-unintensive instruments, respectively; Industrial/Govnerment/Services share are the logarithm of the sectoral value added share in GDP; Income per capita is logarithm of GDP per capita; Financial development is the logarithm of M3 money supply as a fraction of GDP. IPR-protection is the Intellectual Property Rights Protection Index from Ginarte and Park (1997), updated by Park (2008). IPR data are available every 5 years, so we linearly interpolate between observations within a country. For further details on sample and variables see Appendix.

Table 9: Capital Complementarity to Skilled and Unskilled Labor, EU-KLEMS data, 1970-2005

Dependent variable: Wage bill share of skilled workers

A. Narrow definition of skilled labor: University-equivalent tertiary education

Capital type:	Computing equipment	Communication equipment	Software	Transport equipment	Machinery	-	Total
	0.21***	0.13*	0.19***	-0.49***	-0.66***		0.23***
	(0.03)	(0.08)	(0.05)	(0.08)	(0.09)		(0.03)
ICT (groups 1,2,3)						0.21***	
						(0.06)	
Non-ICT (groups 4,5)						-0.54***	
						(0.12)	
Observations	345	345	345	345	345	345	345
No. of countries	14	14	14	14	14	14	14

B. Broad definition of skilled labor: At least high-school

Capital type:	Computing equipment	Communication equipment	Software	Transport equipment	Machinery	-	Total
	0.07***	0.16***	0.04***	-0.15***	-0.17***		0.09***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)		(0.010)
ICT (groups 1,2,3)						0.10***	
						(0.024)	
Non-ICT (groups 4,5)						-0.18***	
						(0.044)	
Observations	345	345	345	345	345	345	345
No. of countries	14	14	14	14	14	14	14

Notes: This table reports TSLS estimates of γ1 in the regression $S = \beta*\ln(wH/wL) + \gamma1*\log(capital\_j/output) + \gamma2*\log(capital\_{-j}/output) + \varepsilon$, for different capital types j, where capital_-j is total capital stock net of capital_j. S is the wage bill share of skilled workers and wH/wL is the relative wage of skilled to unskilled workers. Positive coefficients indicate complementarity to skilled workers; negative coefficients indicate complementarity to unskilled workers. Instruments to capital shares are their 1-period lagged values; all first stage results report F-statistics for weak instruments an order of magnitude greater than 10. All regressions include time and country fixed effects. Data: EU KLEMS. Standard errors in parentheses are clustered at the country level. *** p<0.01, ** p<0.05, * p<0.1.

Table 10: Capital Complementarity to Skilled and Unskilled Labor, Imputed Capital Stocks

Dependent variable: Wage bill share of skilled workers

A. Narrow definition of skilled labor: University-equivalent tertiary education

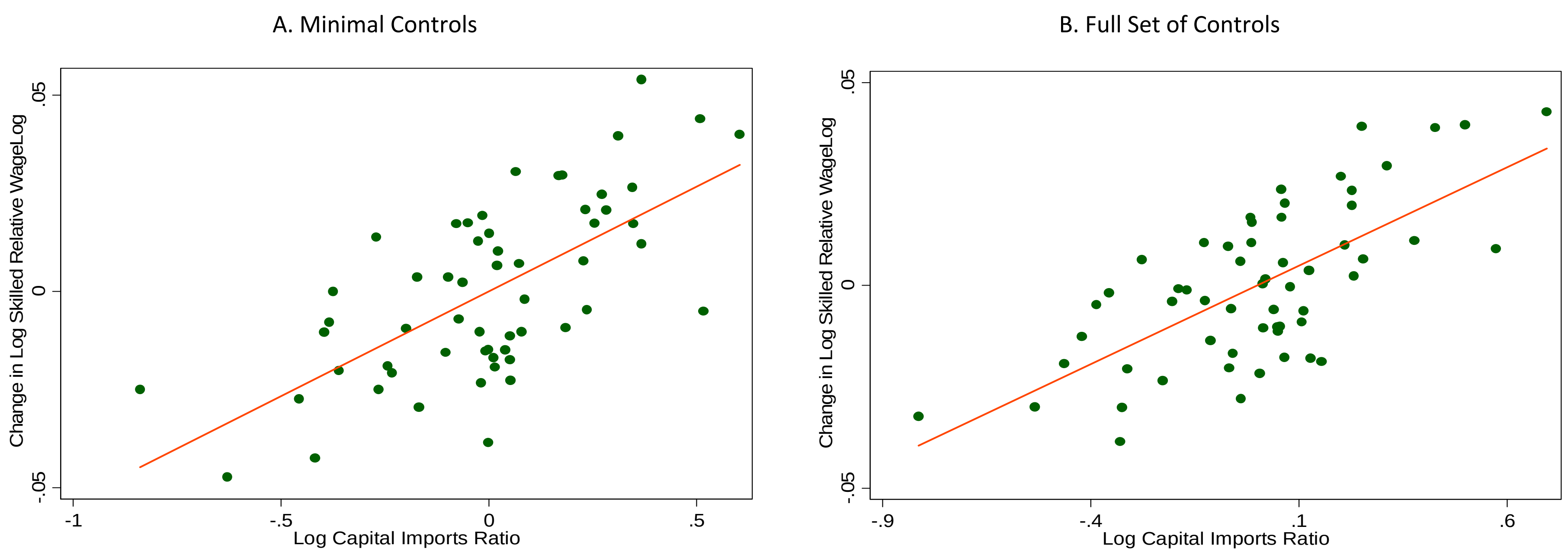
R&D intensity rank:	1	2	3	4	5	6	7	8	9	-	-
Capital type:	Aircraft equipment	Office, computing, and accounting machinery	Communication equipment	Professional goods	Electrical equipment, excluding communication	Motor vehicles	Non-electrical equipment	Other transportation equipment	Fabricated metal products	-	Total
	0.43***	0.19***	0.24***	0.11	-0.43***	-0.05	-0.49***	-0.48***	-1.11***		0.40***
	(0.05)	(0.06)	(0.05)	(0.09)	(0.04)	(0.04)	(0.19)	(0.09)	(0.17)		(0.07)
KH (R&D ranks 1,2,3)										0.79***	
										(0.08)	
KL (R&D ranks 5,7,8,9)										-0.79***	
										(0.12)	
KN (R&D ranks 4,6)										-0.02	
										(0.04)	
Observations	306	306	306	306	306	306	306	306	306	306	306
No. of countries	17	17	17	17	17	17	17	17	17	17	17

B. Broad definition of skilled labor: At least high-school

R&D intensity rank:	1	2	3	4	5	6	7	8	9	-	-
Capital type:	Aircraft equipment	Office, computing, and accounting machinery	Communication equipment	Professional goods	Electrical equipment, excluding communication	Motor vehicles	Non-electrical equipment	Other transportation equipment	Fabricated metal products	-	Total
	0.17	0.11***	0.14***	0.01	-0.21***	0.16**	-0.07	-0.28***	-0.59***		0.23***
	(0.15)	(0.04)	(0.05)	(0.08)	(0.05)	(0.08)	(0.19)	(0.07)	(0.19)		(0.08)
KH (R&D ranks 1,2,3)										0.43***	
										(0.09)	
KL (R&D ranks 5,7,8,9)										-0.43***	
										(0.11)	
KN (R&D ranks 4,6)										0.15**	
										(0.07)	
Observations	306	306	306	306	306	306	306	306	306	306	306
No. of countries	17	17	17	17	17	17	17	17	17	17	17

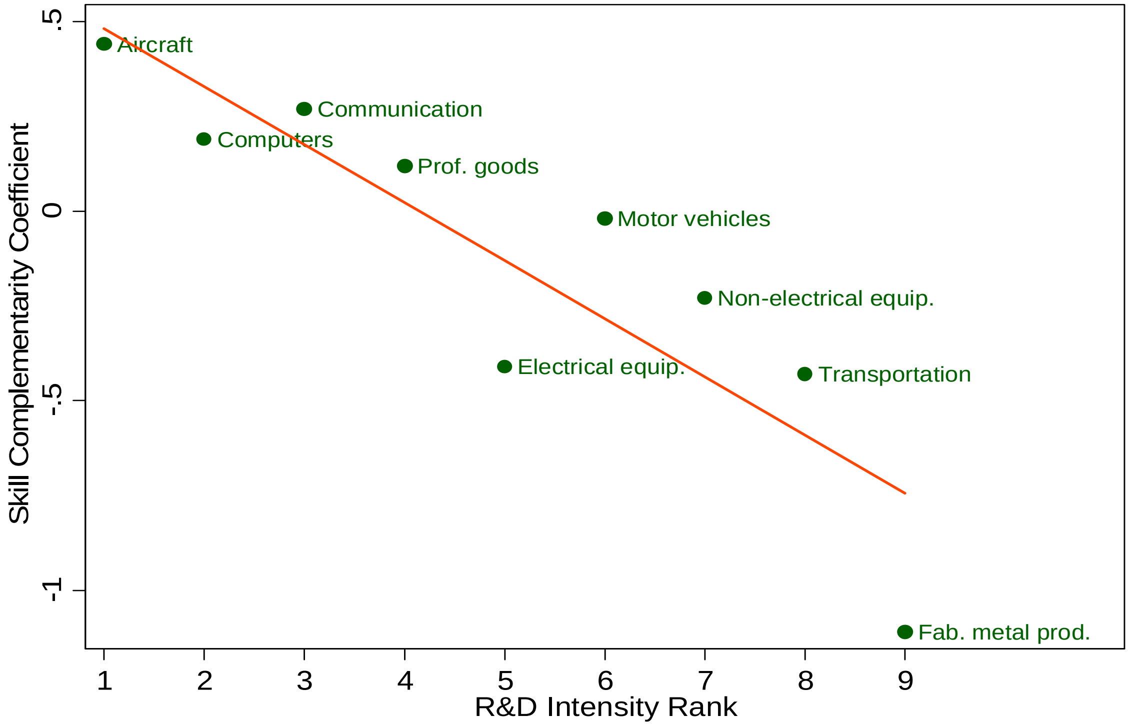
Notes: This table reports TSLS estimates of $\gamma 1$ in the regression $S = \beta*\ln(wH/wL) + \gamma 1*\log(capital\_j/output) + \gamma 2*\log(capital\_-j/output) + \varepsilon$, for different capital types j, where capital_-j is total capital stock net of capital_j. S is the wage bill share of skilled workers and wH/wL is the relative wage of skilled to unskilled workers. Positive coefficients indicate complementarity to skilled workers; negative coefficients indicate complementarity to unskilled workers. Instruments to capital shares are their 1-period lagged values; all first stage results report F-statistics for weak instruments an order of magnitude greater than 10. All regressions include time and country fixed effects. All data except capital stocks are from the EU KLEMS. Capital stocks are imputed perpetual inventory method; see text for details. Standard errors in parentheses are clustered at the country level. *** p<0.01, ** p<0.05, * p<0.1.

Figure 1: Wage Inequality and the Composition of Capital Imports, 1983-1997



Notes: Both figures present conditional correlations between changes in log skilled relative wage, defined as the wage of non-production workers to production workers, and the capital import ratio. The latter is defined as the ratio of R&D-intensive capital equipment imports relative to less innovative capital equipment imports. In Panel A we control for the change in skill abundance and country fixed effects; the slope is 0.053 with partial R-squared of 0.44. In Panel B we control in addition for overall capital imports/GDP and shifts in export shares, the latter defined as the degree to which export shares from countries in the sample shift towards more skill intensive goods (Zhu and Trefler, 2005); the slope is 0.048 with partial R-squared of 0.47.

Figure 2: Technology and Complementarity to Skill



Notes: R&D intensity rank of capital goods group is from Caselli and Wilson (2004); lower numbers mean higher R&D intensity. The skill complementarity coefficient for each capital goods group is estimated in Table 10; higher numbers mean stronger complementarity with skilled labor, and negative numbers mean stronger complementarity with unskilled labor. The correlation between R&D intensity rank and complementarity coefficient is 0.89.

APPENDIX TABLES AND FIGURES

Table A1: Contribution of ICT and non-ICT Capital to Changes in Demand for Skill

A. Annualized percent contribution to aggregate skill intensity

	Employment share		Wagebill share	
	ICT	Non-ICT	ICT	Non-ICT
EU15	0.170	0.396	0.156	0.360
Japan	0.118	0.405	0.119	0.419
South Korea	0.034	0.223	0.035	0.226
U.S.	0.049	0.131	0.046	0.129
Czech Republic	0.029	0.064	0.029	0.052
Hungary	0.077	1.363	0.048	1.395

B. Annualized percent contribution to skill intensity in manufacturing

	Employment share		Wagebill share	
	ICT	Non-ICT	ICT	Non-ICT
EU15	0.047	0.042	0.050	0.042
Japan	0.017	0.034	0.017	0.044
South Korea	0.016	0.999	0.017	1.047
U.S.	0.006	0.017	0.009	0.018
Czech Republic	0.037	0.230	0.044	0.250
Hungary	0.235	1.566	0.313	1.906

Notes: Sample for EU15, Japan, South Korea, U.S. is 1983-1997. Sample for Czech Republic, Hungary is 1995-1999. See Appendix for details on the exact calculations made.

Table A2: Capital Import Composition and the Skill Premium, 1983-1997, OLS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δln(H/L)	0.02	0.07	0.09	0.07	0.08	0.08	0.09
	(0.13)	(0.07)	(0.07)	(0.06)	(0.06)	(0.07)	(0.07)
ln(MH/ML)		0.05***	0.06***	0.05***			
		(0.01)	(0.01)	(0.01)			
ln(M)	0.01	0.01	0.003	-0.006			
	(0.01)	(0.01)	(0.01)	(0.01)			
Δz				0.58***	0.56***		
				(0.17)	(0.18)		
ln(MH)					0.047***	0.053***	0.066***
					(0.01)	(0.01)	(0.01)
ln(ML)					-0.046***	-0.049***	-0.06***
					(0.01)	(0.01)	(0.01)
ln(MN)					-0.001	0.007	0.006
					(0.01)	(0.01)	(0.01)
R-squared, within	0.02	0.45	0.58	0.6	0.59	0.47	0.59
Obs.	58	58	58	58	58	58	58
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	No	Yes	No	No	No	Yes

Notes: OLS estimates. 20 countries in all specifications. Robust standard errors, clustered by country, in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Δln(wH/wL) is change in the logarithm of skilled relative wage; Δln(H/L) is change in logarithm of relative supply of skill; Δz is shift in export shares; ln(MH/ML) is the logarithm of the ratio of R&D-intensive capital imports to R&D-unintensive capital imports; ln(M) is the logarithm of aggregate capital imports, whereas similarly MH, ML. and MN refer to the R&D intensive, unintensive, and intermediate-intensive capital imports groups, respectively. Nominal imports are deflated to 2000 prices in US dollars using the CPI. For further details on sample and variables see Appendix.

Table A3: Capital Import Composition and the Skill Premium, 1983-1997, OLS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δln(H/L)	0.03	0.07	0.09	0.07	0.09	0.08	0.11
	(0.13)	(0.07)	(0.07)	(0.06)	(0.06)	(0.07)	(0.07)
ln(MH/ML)		0.05***	0.07***	0.05***			
		(0.01)	(0.01)	(0.01)			
ln(M/POP)	0.02	0.01	0.01	-0.006			
	(0.02)	(0.01)	(0.01)	(0.01)			
Δz				0.57***	0.55***		
				(0.17)	(0.18)		
ln(MH/POP)					0.048***	0.052***	0.067***
					(0.01)	(0.01)	(0.01)
ln(ML/POP)					-0.045***	-0.048***	-0.057***
					(0.01)	(0.01)	(0.01)
ln(MN/POP)					-0.00	0.01	0.01
					(0.01)	(0.01)	(0.01)
R-squared, within	0.03	0.45	0.58	0.6	0.59	0.59	0.59
Obs.	58	58	58	58	58	58	58
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	No	Yes	No	No	No	Yes

Notes: OLS estimates. 20 countries in all specifications. Robust standard errors, clustered by country, in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Δln(wH/wL) is change in the logarithm of skilled relative wage; Δln(H/L) is change in logarithm of relative supply of skill; Δz is shift in export shares; ln(MH/ML) is the logarithm of the ratio of R&D-intensive capital imports to R&D-unintensive capital imports; ln(M/POP) is the logarithm of aggregate capital imports normalized by population, whereas similarly MH, ML. and MN refer to the R&D intensive, unintensive, and intermediate-intensive capital imports groups, respectively. For further details on sample and variables see Appendix.

Table A4: Capital Import Composition and the Skill Premium, 1983-1997, OLS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δln(H/L)	0.03	0.06	0.15*	0.09	0.1	0.08	0.05**
	(0.15)	(0.08)	(0.07)	(0.06)	(0.06)	(0.08)	(0.07)
ln(MH/ML)		0.05***	0.06***	0.05***			
		(0.01)	(0.01)	(0.01)			
ln(M/K)	0.02	-0.00	0.01	-0.00			
	(0.02)	(0.01)	(0.01)	(0.01)			
Δz				0.55***	0.56***		
				(0.16)	(0.18)		
ln(MH/K)					0.05***	0.05***	0.07***
					(0.01)	(0.01)	(0.01)
ln(ML/K)					-0.04***	-0.05***	-0.06***
					(0.01)	(0.01)	(0.01)
ln(MN/K)					0.003	0.01	0.01
					(0.01)	(0.01)	(0.01)
R-squared, within	0.02	0.44	0.61	0.6	0.6	0.46	0.62
Obs.	58	58	58	58	58	58	58
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	No	Yes	No	No	No	Yes

Notes: OLS estimates. 20 countries in all specifications. Robust standard errors, clustered by country, in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Δln(wH/wL) is change in the logarithm of skilled relative wage; Δln(H/L) is change in logarithm of relative supply of skill; Δz is shift in export shares; ln(MH/ML) is the logarithm of the ratio of R&D-intensive capital imports to R&D-unintensive capital imports; ln(M/K) is the logarithm of aggregate capital imports normalized by total capital stock (Penn World Tables, mark 8.0), and similarly for MH, ML and MN, which are the R&D intensive, unintensive, and intermediate-intensive capital imports groups, respectively. For further details on sample and variables see Appendix.

Table A5: Capital Import Composition and the Skill Premium, 1983-1997, OLS -- Exporting countries excluded

	Dependent variable: Δln(wH/wL)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δln(H/L)	0.001	-0.07	0.04	0.09	0.07	0.09	0.07	0.09
	(0.09)	(0.17)	(0.09)	(0.1)	(0.07)	(0.1)	(0.07)	(0.09)
ln(MH/ML)	0.05***		0.06***	0.07***	0.05***			
	(0.01)		(0.01)	(0.01)	(0.01)			
ln(M/GDP)		0.01	0.01	0.01	0.01			
		(0.01)	(0.01)	(0.01)	(0.01)			
Δz					0.48***		0.48**	0.36*
					(0.18)		(0.2)	(0.18)
ln(MH/GDP)						0.074***	0.052***	0.066***
						(0.01)	(0.01)	(0.01)
ln(ML/GDP)						-0.074***	-0.045***	-0.065***
						(0.01)	(0.01)	(0.02)
ln(MN/GDP)						0.01	0.002	0.005
						(0.01)	(0.01)	(0.01)
R-squared, within	0.49	0.03	0.52	0.65	0.64	0.66	0.65	0.71
Observations	37	37	37	37	37	37	37	37
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period FE	No	No	No	Yes	No	Yes	No	Yes

Notes: OLS estimates. In all specifications we exclude countries that export at least half the amount they import (in the respective capital group); these include: Hong Kong, India, Korea, Mexico, Philippines, Singapore, and Thailand. Robust standard errors, clustered by country, in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Δln(wH/wL) is change in the logarithm of skilled relative wage; Δln(H/L) is change in logarithm of relative supply of skill; Δz is shift in export shares; ln(MH/ML) is the logarithm of the ratio of R&D-intensive capital imports to R&D-unintensive capital imports; ln(M/GDP) is the logarithm of aggregate capital imports normalized by GDP, whereas similarly MH, ML. and MN refer to the R&D intensive, unintensive, and intermediate-intensive capital imports groups, respectively. For further details on sample and variables see Appendix.

Table A6: Capital Import Composition and the Skill Premium, 1983-1997, TSLS - Exporting countries excluded

A. Two stage least squares estimates

	Dependent variable: Δln(wH/wL)		
	(1)	(2)	(3)
Δln(H/L)	0.02	0.06	0.05
	(0.08)	(0.1)	(0.08)
Δz			0.49***
			(0.17)
ln(MH/ML)	0.05***	0.06***	0.05***
	(0.01)	(0.01)	(0.01)
ln(M/GDP)	0.007	-0.003	0.002
	(0.01)	(0.01)	(0.01)
R-squared, within	0.51	0.63	0.64
Observations	37	37	37
Country FE	Yes	Yes	Yes
Period FE	No	Yes	No

B. First stage results

Specification in Panel A:	(1)	(1)	(2)	(2)	(3)	(3)
Endogenous Dep. Var.:	ln(MH/ML)	ln(M/GDP)	ln(MH/ML)	ln(M/GDP)	ln(MH/ML)	ln(M/GDP)
Δln(uvH)	-82.7***	-10.39	-70.83***	-13.69	-80.54***	-8.29
	(17.71)	(21.84)	(16.12)	(21.69)	(19.5)	(21.47)
Δln(uvL)	60.95***	-77.29***	42.8***	-82.78***	61.76***	-76.51***
	(11.87)	(17.38)	(12.41)	(17.14)	(13.47)	(17.65)
F-stat for weak instruments	20.63	12.2	12.74	17.25	15.6	11.27

Notes: TSLS estimates in Panel A, where the import variables are endogenous. Panel B reports first stage estimates of excluded exogenous instruments; all other coefficients are suppressed for brevity. In Panel B each column refers to a specification and an endogenous variable from Panel A. In all specifications we exclude countries that export at least half the amount they import (in the respective capital group); these include: Hong Kong, India, Korea, Mexico, Philippines, Singapore, and Thailand. Standard errors clustered by country in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Δln(wH/wL) is change in the logarithm of skilled relative wage; Δln(H/L) is change in logarithm of relative supply of skill; Δz is shift in export shares as in Zhu and Trefler (2005); ln(MH/ML) is the logarithm of the ratio of R&D-intensive capital imports to R&D-unintensive capital imports; ln(M/GDP) is the logarithm of aggregate capital imports normalized by GDP. Δln(uvH), and Δln(uvL) are the R&D-intensive , and R&D-unintensive instruments, respectively. These instruments are changes in average unit values of top three supplier-countries' exports to all countries excluding the importing country, within each capital group. For further details on countries in the sample, data construction and sources, see Appendix.

Table A7: Capital Stock Shares and Changes in Capital Stock Shares, Five Equipment Groups, EU KLEMS data

A. Average capital stock shares

Capital type:		Computing equipment	Communication equipment	Software	Transportation equipment	Machinery	ICT Capital (Computers + Communication + Software)	Non-ICT Capital (Transportation + Machinery)
Australia	1970 - 2005	0.065	0.062	0.033	0.530	0.309	0.161	0.839
Austria	1976 - 2005	0.042	0.065	0.014	0.691	0.188	0.122	0.878
Czech Republic	1995 - 2005	0.129	0.051	0.016	0.626	0.178	0.196	0.803
Denmark	1970 - 2005	0.070	0.013	0.035	0.591	0.291	0.118	0.882
Finland	1970 - 2005	0.025	0.053	0.044	0.597	0.281	0.121	0.879
Germany	1970 - 2005	0.046	0.071	0.029	0.656	0.198	0.146	0.854
Italy	1970 - 2005	0.023	0.069	0.019	0.712	0.176	0.112	0.888
Japan	1970 - 2005	0.044	0.063	0.028	0.647	0.218	0.135	0.865
Netherlands	1970 - 2005	0.056	0.074	0.036	0.565	0.270	0.165	0.835
Portugal	1995 - 2005	0.163	0.052	0.018	0.544	0.222	0.233	0.767
Slovenia	1995 - 2005	0.100	0.175	0.023	0.550	0.152	0.298	0.702
Sweden	1993 - 2005	0.054	0.072	0.080	0.644	0.149	0.207	0.793
United Kingdom	1970 - 2005	0.050	0.033	0.050	0.634	0.233	0.133	0.867
United States	1970 - 2005	0.052	0.090	0.046	0.596	0.216	0.188	0.812
Average		0.066	0.067	0.034	0.613	0.220	0.167	0.833

B. Changes in capital stock shares

Capital type:		Computing equipment	Communication equipment	Software	Transportation equipment	Machinery	ICT Capital (Computers + Communication + Software)	Non-ICT Capital (Transportation + Machinery)
Australia	1970 - 2005	0.366	-0.007	0.079	-0.288	-0.149	0.437	-0.437
Austria	1976 - 2005	0.204	0.045	0.040	-0.315	0.027	0.288	-0.288
Czech Republic	1995 - 2005	0.108	0.007	-0.003	-0.176	0.063	0.113	-0.112
Denmark	1970 - 2005	0.337	0.011	0.090	-0.319	-0.119	0.438	-0.438
Finland	1970 - 2005	0.096	0.190	0.080	-0.210	-0.155	0.366	-0.366
Germany	1970 - 2005	0.153	0.053	0.046	-0.092	-0.160	0.252	-0.252
Italy	1970 - 2005	0.112	0.019	0.031	-0.100	-0.063	0.163	-0.163
Japan	1970 - 2005	0.117	0.057	0.051	-0.163	-0.060	0.224	-0.223
Netherlands	1970 - 2005	0.291	0.024	0.075	-0.316	-0.074	0.390	-0.390
Portugal	1995 - 2005	0.250	0.025	0.015	-0.249	-0.041	0.289	-0.289
Slovenia	1995 - 2005	0.068	-0.176	0.043	0.034	0.030	-0.064	0.064
Sweden	1993 - 2005	0.054	0.021	-0.022	0.017	-0.069	0.052	-0.052
United Kingdom	1970 - 2005	0.262	0.080	0.067	-0.273	-0.136	0.409	-0.409
United States	1970 - 2005	0.257	0.082	0.108	-0.310	-0.137	0.447	-0.447
Average		0.191	0.031	0.050	-0.197	-0.075	0.272	-0.272

Notes: In Panel A capital stock shares are computed as shares in total nominal capital stock and averaged over all available years. In Panel B changes in capital stock shares are computed as the share in the last year minus the share in the first year. Samples are noted next to each country. Averages over all countries are reported below country data. Data is from the EU KLEMS dataset (O'Mahony and Timmer, 2009).

Table A8: Capital Complementarity to Skilled and Unskilled Labor, EU-KLEMS data, 1970-2005 -- Regressions in Changes

	Dependent variable: Change in wage bill share of skilled workers						
A. Narrow definition of skilled labor: University-equivalent tertiary education							
Capital type:	Computing equipment	Communication equipment	Software	Transport equipment	Machinery	-	Total
	0.54***	0.45***	0.25***	-1.08***	-2.01***		0.48***
	(0.02)	(0.02)	(0.01)	(0.04)	(0.04)		(0.01)
ICT (groups 1,2,3)						0.71***	
						(0.01)	
Non-ICT (groups 4,5)						-1.02***	
						(0.04)	
Observations	327	327	327	327	327	327	327
No. of countries	14	14	14	14	14	14	14
B. Broad definition of skilled labor: At least high-school							
Capital type:	Computing equipment	Communication equipment	Software	Transport equipment	Machinery	-	Total
	0.18***	0.22***	0.06***	-0.43***	-0.62***		0.16***
	(0.004)	(0.01)	(0.001)	(0.02)	(0.01)		(0.001)
ICT (groups 1,2,3)						0.32***	
						(0.003)	
Non-ICT (groups 4,5)						-0.34***	
						(0.01)	
Observations	327	327	327	327	327	327	327
No. of countries	14	14	14	14	14	14	14

Notes: This table reports TSLS estimates of γ1 in the regression $\Delta S = \beta*\Delta \ln(wH/wL) + \gamma1*\Delta \log(capital\_i/output) + \gamma2*\Delta \log(capital\_{-i}/output) + \Delta\varepsilon$, for different capital types i, where capital_-i is total capital net of capital_i. S is the wage bill share of skilled workers and wH/wL is the relative wage of skilled to unskilled workers. Δ is the first difference operator. Positive coefficients indicate complementarity to skilled workers; negative coefficients indicate complementarity to unskilled workers. Instruments for capital shares are their 1-period lagged values (both in changes); all first stage results report F-statistics higher than 1000. All regressions include country fixed effects. Data: EU KLEMS. Standard errors in parentheses are clustered at the country level. *** p<0.01, ** p<0.05, * p<0.1.

Table A9: Capital Stock Shares and Changes in Capital Stock Shares, Nine Equipment Groups, OECD data

A. Average capital stock shares

R&D intensity rank:		1	2	3	4	5	6	7	8	9	1+2+3	4+6	5+7+8+9
Capital type:		Aircraft equipment	Office, computing, and accounting machinery	Communication equipment	Professional goods	Electrical equipment, excluding communication	Motor vehicles	Non-electrical equipment	Other transportation equipment	Fabricated metal products	MH	MN	ML
Austria	1995 - 2005	0.006	0.030	0.104	0.071	0.407	0.172	0.039	0.021	0.150	0.140	0.242	0.618
Belgium	1995 - 2005	0.018	0.022	0.072	0.083	0.305	0.281	0.034	0.012	0.172	0.112	0.365	0.524
Czech Republic	2001 - 2005	0.009	0.051	0.091	0.099	0.404	0.177	0.039	0.012	0.119	0.151	0.276	0.573
Finland	1980 - 2005	0.016	0.040	0.116	0.068	0.523	0.078	0.034	0.012	0.113	0.172	0.146	0.682
France	1978 - 2005	0.053	0.040	0.064	0.065	0.378	0.170	0.060	0.009	0.161	0.157	0.234	0.609
Germany	1980 - 2005	0.022	0.043	0.054	0.137	0.343	0.206	0.047	0.009	0.139	0.119	0.343	0.538
Hungary	1992 - 2005	0.004	0.043	0.136	0.087	0.440	0.154	0.035	0.007	0.094	0.183	0.241	0.576
Italy	1980 - 2005	0.027	0.030	0.092	0.110	0.242	0.163	0.053	0.020	0.263	0.149	0.274	0.578
Japan	1986 - 2005	0.011	0.065	0.167	0.102	0.217	0.280	0.029	0.001	0.128	0.243	0.382	0.374
Korea	1994 - 2005	0.011	0.031	0.287	0.092	0.228	0.199	0.049	0.009	0.094	0.329	0.291	0.380
Netherlands	1985 - 2005	0.032	0.049	0.165	0.065	0.229	0.181	0.040	0.018	0.220	0.245	0.247	0.508
Poland	1996 - 2005	0.011	0.049	0.100	0.098	0.270	0.226	0.057	0.018	0.173	0.160	0.323	0.517
Slovenia	1995 - 2005	0.005	0.049	0.083	0.116	0.191	0.247	0.053	0.016	0.240	0.137	0.363	0.500
Spain	1980 2005	0.017	0.053	0.072	0.102	0.198	0.277	0.048	0.020	0.213	0.142	0.379	0.479
Sweden	1980 2005	0.030	0.048	0.102	0.089	0.256	0.246	0.056	0.018	0.154	0.180	0.335	0.485
United Kingdom	1980 2005	0.065	0.082	0.096	0.086	0.191	0.236	0.063	0.015	0.165	0.244	0.322	0.434
United States	1980 2005	0.070	0.063	0.123	0.074	0.155	0.287	0.060	0.012	0.156	0.256	0.361	0.383
Average		0.024	0.046	0.113	0.091	0.293	0.211	0.047	0.014	0.162	0.183	0.301	0.515

B. Changes in capital stock shares

R&D intensity rank:		1	2	3	4	5	6	7	8	9	1+2+3	4+6	5+7+8+9
Capital type:		Aircraft equipment	Office, computing, and accounting machinery	Communication equipment	Professional goods	Electrical equipment, excluding communication	Motor vehicles	Non-electrical equipment	Other transportation equipment	Fabricated metal products	MH	MN	ML
Austria	1995 - 2005	0.008	0.000	-0.027	0.005	-0.029	0.052	0.002	0.011	-0.007	-0.020	0.056	-0.023
Belgium	1995 - 2005	0.000	0.002	0.016	-0.009	-0.021	-0.025	0.004	-0.001	0.042	0.017	-0.034	0.024
Czech Republic	2001 - 2005	0.001	0.002	-0.009	-0.011	-0.003	0.015	-0.006	0.003	0.008	-0.006	0.005	0.002
Finland	1980 - 2005	0.011	0.010	0.146	-0.040	0.020	-0.055	-0.010	-0.010	-0.032	0.167	-0.095	-0.032
France	1978 - 2005	0.032	0.009	0.001	0.005	-0.085	0.086	-0.014	0.006	-0.022	0.042	0.091	-0.115
Germany	1980 - 2005	0.006	0.009	-0.012	-0.062	0.111	0.053	-0.036	0.000	-0.050	0.004	-0.009	0.025
Hungary	1992 - 2005	-0.001	-0.015	0.090	0.029	0.001	0.020	-0.062	-0.001	-0.062	0.074	0.048	-0.124
Italy	1980 - 2005	0.014	0.023	-0.022	0.006	-0.018	0.036	0.010	-0.006	-0.015	0.015	0.041	-0.028
Japan	1986 - 2005	0.003	0.021	0.085	-0.023	-0.051	0.027	-0.023	0.004	-0.040	0.109	0.004	-0.111
Korea	1994 - 2005	0.011	0.045	0.097	0.026	-0.036	-0.031	-0.018	-0.007	0.022	0.153	-0.005	-0.040
Netherlands	1985 - 2005	-0.028	0.007	-0.003	0.005	0.025	0.047	-0.032	0.011	0.046	-0.024	0.052	0.050
Poland	1996 - 2005	0.001	0.005	0.018	-0.007	-0.066	0.020	-0.009	-0.007	0.047	0.024	0.013	-0.035
Slovenia	1995 - 2005	0.002	-0.010	0.013	0.014	-0.030	-0.065	-0.004	-0.004	0.083	0.004	-0.051	0.045
Spain	1980 2005	0.008	0.013	-0.010	-0.030	-0.031	0.117	-0.013	0.000	-0.055	0.012	0.087	-0.099
Sweden	1980 2005	-0.005	0.008	0.027	-0.049	-0.092	0.125	0.021	-0.001	-0.034	0.030	0.076	-0.106
United Kingdom	1980 2005	0.007	0.041	0.007	-0.019	-0.054	0.073	0.001	-0.006	-0.051	0.055	0.053	-0.111
United States	1980 2005	-0.027	0.018	0.040	-0.018	-0.039	0.086	-0.007	-0.007	-0.047	0.032	0.069	-0.099
Average		0.003	0.011	0.027	-0.010	-0.023	0.034	-0.011	-0.001	-0.010	0.040	0.024	-0.046

Notes: In Panel A capital stock shares are computed as shares in total nominal capital stock and averaged over all available years. In Panel B changes in capital stock shares are computed as the share in the last year minus the share in the first year. Samples are noted next to each country. Averages over all countries are reported below country data. Capital stock data was aggregated according to the classification in Table 1 based on data from OECD. Stock are calculated by perpetual inventory method, using capital type specific depreciation. Investment of each capital type is given by I = Y - X + M, where Y is output, X are exports and M are imports (data from OECD). See main text for complete details.

Figure A1: Independent Variation in Unit Value Instruments, 1985-1997

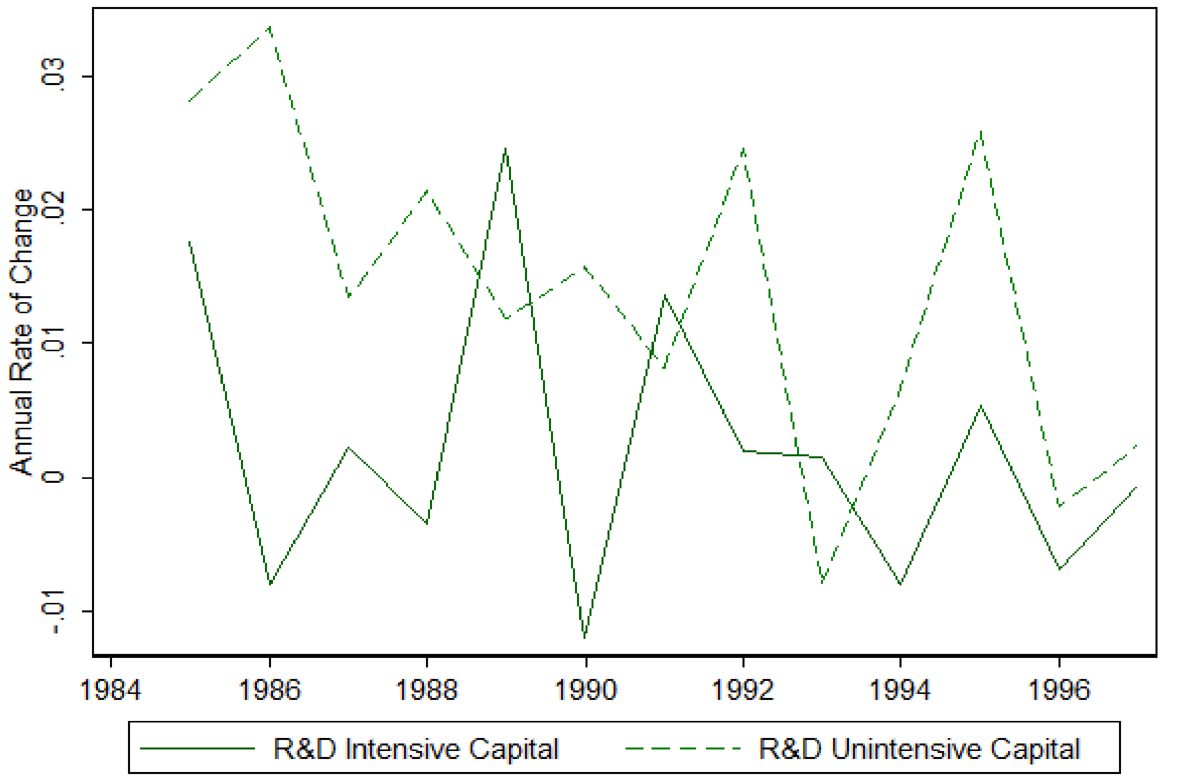
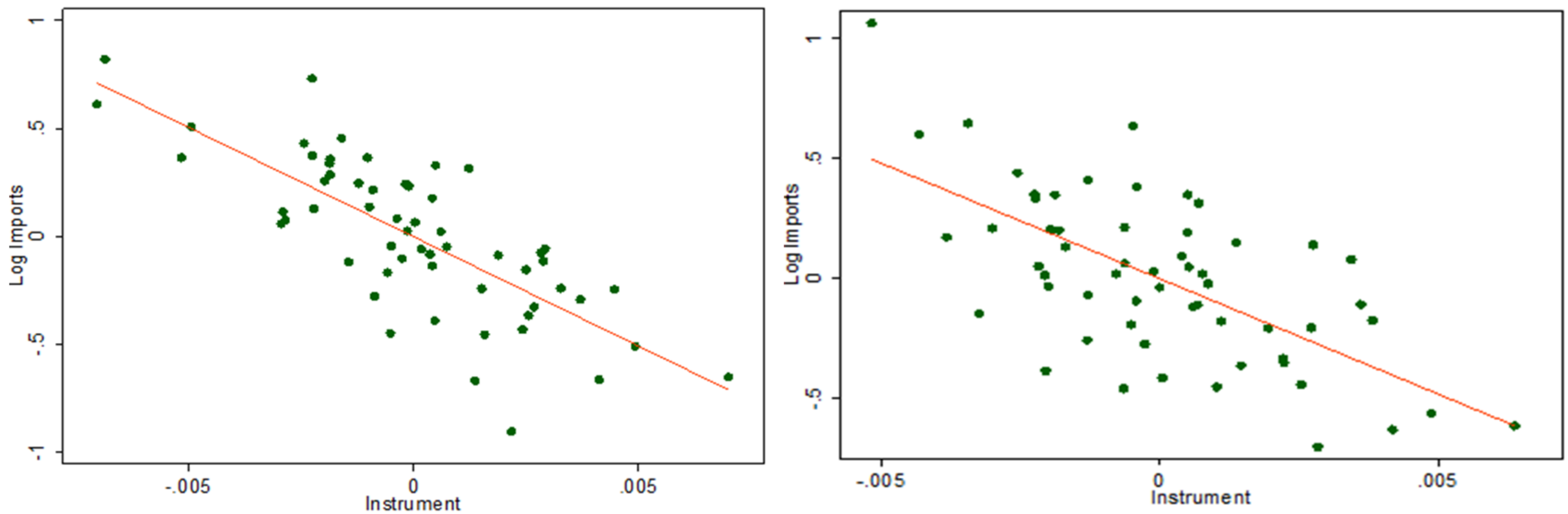


Figure presents the annual rate of change in the average international real unit price of R&D intensive and unintensive capital for the period of 1985-1997. The measure is calculated as a simple average, over all countries, starting at 1985 given data availability on quantity traded.

Figure A2: First Stage Partial Correlations (from Table 4)

A. R&D Unintensive Capital Equipment

B. R&D Intensive Capital Equipment



Figures present conditional correlations from the benchmark first stage regressions, controlling for change in skill intensity, the shift in export shares (Zhu and Trefler 2005), and country fixed effects. In Panel A the slope is -101.48 with partial R-squared of 0.58; in Panel B the slope is -96.08 with partal R-squared of 0.42.