

The Determinants of Capital Intensity in Manufacturing: The Role of Factor Market Imperfections

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Summary. — We study the role of factor market imperfections in determining industry-level capital intensities. Using cross-country panel data on manufacturing industries, we find that labor market imperfections arising from labor regulation have a greater influence on capital intensity than do credit market imperfections. Less restrictive labor regulations are associated with lower capital intensity in manufacturing, especially in middle-income and developing economies and in sectors that either require more frequent labor adjustment or are more unskilled labor intensive. This suggests that stringent labor regulations can impose costs on labor use, thereby curtailing gains from trade based on factor-abundance driven comparative advantage.

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1. INTRODUCTION

Factor markets that bring about an efficient allocation of resources play an important role in the development process. Labor market regulation has often been cited as one of the reasons for poor performance of manufacturing in developing economies, especially those in South Asia and Latin America.¹ Though meant to protect labor, they can adversely affect it by reducing labor demand. This may happen through various elements of labor regulation including restrictions on hiring and firing, minimum wage laws, and the rules governing collective bargaining. Thus, for example, restrictions on layoffs are believed to have hindered industrial expansion to economic scales of production since firms may be reluctant to hire workers who they cannot fire or layoff easily (see Panagariya, 2008 on the Indian case).

In addition, restrictive labor laws can inhibit firms' ability to adjust their labor input to demand and technology shocks including those arising from trade liberalization. Such shocks can therefore induce firms to hire informal workers who often operate in inferior working conditions without basic labor protection (see Goldberg & Pavcnik, 2003 for Latin America) potentially contributing to inequality. Finally, even investment may be hindered in the presence of stringent labor regulation since firms may be more cautious about investment when workers are endowed with greater bargaining power (which enables them to extract a bigger share of the surplus that results from investment).

Equally important for economic development is a developed financial system that facilitates the allocation of funds to productive activities. While normally we believe that financial or credit market imperfections make capital formation more difficult, it is also quite possible that they come in the way of a firm's expansion of the employment of labor.

In this study, we analyze the importance of factor market imperfections in determining capital-intensities in manufacturing across countries. Our study can be placed in the broad literature on the significance of smoothly functioning factor markets in economic development. It especially contributes to the literature on the impact of labor regulations on economic performance (Ahsan & Pagés, 2009; Besley & Burgess, 2004; Bhattacharjea, 2006; Gupta, Hasan, & Kumar, 2009; Hasan, Mitra, & Ramaswamy, 2007; Mitra & Ural, 2008 for India). More specifically, we look at the impact of labor regulation and other factor market imperfections on the technique of production used at the industry level in each country and as measured by factor intensities.² Factor intensities may vary because individual products are produced with different capital intensities across countries, or because product varieties within an industry vary in capital intensity and countries differ in the mix of product varieties they produce.

Our study provides some evidence that onerous labor regulation can be distortionary and may depress employment by altering labor demand, especially in industries that, due to technological compulsions, require frequent adjustments in labor input.³ We carry out a panel analysis that examines the relationship between capital intensities, factor endowments, and measures of labor regulation, and financial development for the period 1994 through 2002.

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Our results indicate that labor market rigidity, brought about by certain types of labor regulation, is an important determinant of techniques used in production across countries, perhaps more so than credit market rigidity. In particular, we find that unit decreases in indexes (that range from 0 to 10) measuring the extent of the freedom from minimum wage regulation, restrictions on hiring and firing, and unemployment benefits are associated with up to a 7%, 17%, and 19% higher capital-labor ratio in manufacturing, respectively. Also, less restrictive labor regulations are associated with lower manufacturing capital intensity in industries that are prone to more frequent labor adjustment, in industries that are unskilled labor intensive and in middle-income and developing economies, relative to advanced economies. These findings highlight the possibility that regulation aimed at protecting the welfare of labor may end up hurting it.

2. THEORETICAL FOUNDATIONS

The theoretical framework for our cross-country analysis is based on Schott (2004).⁴ Schott (2004) posits a Heckscher–Ohlin setting with the modification that product varieties within an industry vary in capital intensity. Thus, some product varieties are more capital intensive than others. Under such a scenario, a country's factor endowment determines its product variety mix. In other words, within each industry, there is specialization (complete or partial) by each country in product varieties, just as there is specialization in products or industries. More capital-abundant countries specialize in the more capital-intensive product varieties just as they also specialize in industries that are, on average, more capital-intensive. In the Lerner diagram in Figure 1 adapted from Schott (2004), the horizontal axis measures labor and the vertical axis measures capital. X and Y are two product varieties manufactured using capital and labor.⁵ $X = 1/P_X$ and $Y = 1/P_Y$ represent the unit-value isoquants where P_X and P_Y are world prices of X and Y under free trade, respectively. Y is more labor intensive than X since for each wage-rental ratio, X warrants a higher capital-labor ratio. The lines with vertical intercepts $1/r$ and $1/r'$, respectively, and horizontal intercepts $1/w$ and $1/w'$, respectively, are isocost lines that measure all the possible combinations of capital and labor that can be bought with one dollar at rental rates r and r' respectively and wages w and w' respectively.

The two unit-value isoquants result in three different cones, each of which represents the various combinations of the two vectors (products) defining the cone. In the two-good world

depicted by Figure 1, labor-intensive countries, with endowments like E' that lie to the right of OK_2 and above the horizontal axis, will specialize in the more labor-intensive product Y , use a capital-labor ratio represented by the ray from the origin to E' and will experience factor prices w' and r' . Under the assumptions of perfect competition in factor markets and constant returns to scale, profit maximization occurs where the unit-value isocost line delineated by the intercepts $1/r'$ and $1/w'$ is tangent to the unit-value isoquant Y . At this point, the zero profit condition also holds.

More capital-abundant countries with endowment points like E , however, will produce both X and Y with techniques κ_1 and κ_2 respectively. For instance, OME (which is a combination of the solid line OM and dotted line ME) represents combinations of capital and labor used for the production of product varieties X and Y . Note that in the two-good scenario, this cone in between OK_1 and OK_2 is the only true cone of diversification, as in the other two cones there is complete specialization. The wage-rental ratio in this economy will then be w/r . In fact, under trade, all countries with endowment points between lines OK_1 and OK_2 will have a wage-rental ratio of w/r in equilibrium. In other words, factor price equalization occurs within the cone represented by product mixes in the region between OK_1 and OK_2 . By a similar argument, countries with factor endowment points to the left of OK_1 and to the right of the vertical axis will specialize in the production of the capital-intensive product variety X and will have a higher wage-rental ratio than countries with endowments like E and E' .

This means that country factor endowments determine a country's product and/or product variety mix under trade. This also means that if we are looking at varieties within the same industry, the average capital intensity within the industry will appear to be higher in more capital-abundant countries as they will produce relatively more of the more capital-intensive varieties. The analysis can be generalized for a situation with more than two products or product varieties (different varieties of differing factor intensities of each broadly defined good). Unit-value isoquants based on free trade world prices will determine cones of diversification, given which, a country's endowment vector will determine its product and product variety mix and also its factor intensities and factor prices in equilibrium. In fact, in a world with many (not just two) products and/or product varieties, we can get several cones of diversification.

Factor price equalization results across countries with endowments within each cone of diversification except for extreme endowment points that result in countries specializing completely in one product variety, in which case different factor endowments could result in different factor prices and factor ratios. This means that in a free trade equilibrium, capital-abundant countries will choose to specialize in the more capital-intensive product varieties within each product category or industry and will, therefore, exhibit higher average capital intensity within an industry. Under complete specialization, even within a product variety, a more capital abundant country will use a more capital-intensive technique of production. Hence, we can write the factor ratio employed by a country in an industry with different product varieties as a function of its factor endowment:

$$k_{ic}/l_{ic} = \kappa_i(K_c/L_c) \quad (2.1)$$

where ' i ' refers to industry and ' c ' to country, k_{ic} stands for capital used in an industry, l_{ic} for labor used and K_c and L_c are country factor endowments.

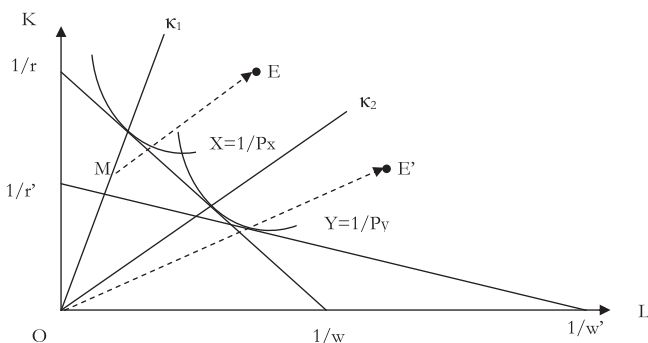


Figure 1. Cones of diversification and specialization in a Heckscher–Ohlin setting.

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