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The determinants of capital intensity in Japan and the US

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ABSTRACT

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We estimate the determinants of capital intensity in Japan and the US, characterized by striking different paths. We augment an otherwise standard Constant Elasticity of Substitution (CES) model with demand-side considerations, which we find especially relevant in the US. In this augmented setting, the elasticity of substitution between capital and labor is placed between 0.74 and 0.90 in Japan, and around 0.30 in the US. We also find evidence of biased technical change, which is capital-saving in Japan but labor-saving in the US. These differences help us explain the diverse experience in the capital deepening process of these economies, and lead us to conclude that demand-side drivers, quite relevant in the US, may also be relevant to account for different growth experiences. A close look at the nature of technological change is also needed before designing one-size-fits-all industrial, economic growth, and/or labor market policies. *J. Japanese Int. Economies xxx (xx) (2014) xxx–xxx*. Departament d'Economia Aplicada, Universitat Autònoma de Barcelona, Edifici B, 08193 Bellaterra, Spain; IZA, Germany.

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1. Introduction

Although capital intensity, i.e. the ratio of capital stock over employment, plays a central role in economic growth models, it is generally considered as an input variable. No effort is devoted to the empirical assessment of its determinants in spite, for example, of the contrasted trajectory of capital intensity across countries, or in spite of the limitation that this imposes in growth accounting analysis.¹

This paper intends to fill this void by providing evidence on the determinants of capital intensity in two economies with different trajectories: Japan and the United States. As shown in Fig. 1, the different time paths followed by the capital-per-worker ratio is itself calling for an empirical analysis of its causes.

The progress of capital intensity was especially intense in Japan, where the amount of capital stock per employee grew almost sixfold between 1960 and 2011, in contrast to the US, where it less than doubled (Fig. 1a). The origin of these differences lies in the very dynamic process of capital deepening linked to the industrialization process experienced by Japan in the 1960s and 1970s. However, after peaking in the first half of the 1970s, the growth rate of capital intensity has evolved around a steady downward path (Fig. 1b). On the contrary, the process of capital deepening in the US accelerated from the mid 1980s until 2009 when the Great Recession caused a sudden fall similar to those occurred in the aftermath of the oil prices shocks.

To investigate on the determinants of capital intensity, we depart from a standard Constant Elasticity of Substitution (CES) model – along the lines, among others, of Antràs (2004) and McAdam and Willman (2013) – and relax the assumptions of perfect competition and perfect information. In this way, we force firms to deal with product demand uncertainty, which they do by adjusting their degree of factor utilization *ex post*, once investment decisions have already been made. In this context, capital intensity is driven by supply-side factors (i.e., factor costs and technology) as well as by demand-side conditions. The result is a model of capital intensity where the capital-per-worker ratio is explained by the relative factor cost – which is the main supply-side driver, relative factor utilization – which is the main demand-side driver, and technological change – which, as standard, is assumed to grow at a constant rate. Following related literature (e.g., Madsen, 2010; Hutchinson and Persyn, 2012), additional empirical controls related to the tax system and the degree of exposure to international trade are considered.²

In this way, our paper contributes to the literature in three main dimensions. First of all, in considering an extended CES model with demand-side considerations arising from the existence of imperfect competition and imperfect information. Second, in providing an empirical account of the determinants of capital intensity in this wider than usual perspective, including updated estimates of the elasticity of substitution between capital and labor. Third, in identifying the different nature of factor-biased technical change in Japan and the US, in response to the recent ‘call for results’ by McAdam and Willman (2013, p. 698): “... despite renewed interest in models of biased technical change, the corresponding empirical effort to identify (i.e., measure) episodes from macro data has been lacking.”

In a first quantitative analysis, the estimated models are used to explore the explanatory power of the supply-side factors. We measure, in particular, the relative incidence of efficiency and technology. We find the latter to overwhelm the former in Japan, and to provide a close account of the facts when taken together. In contrast, the relative incidence of these two factors in the US compensates one another. Hence, when their joint influence is evaluated, wide space is left to demand-side determinants.

In a second exercise we conduct dynamic accounting simulations. In each of them, the time path of capital intensity is evaluated as a result of different counterfactual scenarios that affect each empirical determinant of capital intensity. As expected, we find relative factor costs to be crucial in explaining

¹ Madsen (2010), for example, points out that a problem associated with the traditional growth accounting framework is the lack of information about the factors responsible for the evolution of capital intensity.

² A different way of looking into capital intensity is the one by Hasan et al. (2013) in a Heckscher–Ohlin setup. They argue that labor and capital market regulations determine the industry-level capital stock per worker, and claim that restrictive labor laws can curb firms’ ability to adjust their labor demand to shocks in demand, technology and trade.

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