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Capital/Labor substitution, capital deepening, and FDI

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ABSTRACT

Empirical studies show that the elasticity of substitution between capital and labor is larger than one in developed countries but smaller in developing countries. This paper develops a production function which allows for this structure in the elasticity of substitution. The case of a falling real interest rate and capital deepening in the developed countries in the presence of FDI flows is analyzed. It is shown that this structure in the elasticity of substitution can be responsible for different types of relationships between the capital intensity of the developed country and the relative capital intensity of the developing country. They carry over to an first increasing and later eventually decreasing relationship between the capital intensity of the developed country and FDI profitability.

1. Introduction

While current research in explaining FDI patterns is heavily focused on heterogeneity of firms and industries with respect to productivity and sector or firm size (see e.g. the recent review of the literature in Helpman, 2006), this paper looks from a more macroeconomic point of view onto the phenomenon of FDI. Its main argument relies on the heterogeneity of the elasticity of substitution between capital and labor among different countries and the development of the real interest rate. When looking at developed and less developed countries (see e.g. Duffy and Papageorgiou, 2000 or Pereira, 2002) it seems that more developed countries are characterized by an elasticity of substitution above one while developing countries have an elasticity below one. This together with a falling real interest rate and capital deepening[1] in the developed country over a longer time horizon can give rise to a first increasing and later eventually decreasing pattern in FDI flows as will be argued below.

Working out the determinants of FDI from the theoretical point of view, Helpman (2006) broughtly distinguishes between reasons related to productivity heterogeneity and incomplete contracts. The latter is not the focus of the present paper. Regarding the first argument, the main theoretical contribution to the literature is the Melitz (2003) model with monopolistic competition and heterogeneous firms on which a large strand of the subsequent literature is build on.[2] Subsequent developed models took account of more complex firm strategies involved in FDI as horizontal and vertical integration

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[1] With capital deepening an increase in the ratio of capital and labor used in production is meant here.

[2] E.g. Helpman et al. (2004) or Grossman et al. (2005).

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strategies or export platform structures[3] (e.g. Yeaple, 2003). This literature points on several issues touching upon the firm's decision of whether to pursue FDI or not. From this theoretical point of view, the main results are that more productive and larger firms are engaged in trade and FDI compared to firms which serve only their domestic market. This finding is concordance with empirical findings. The knowledge capital model developed by Markusen et al. (1996) and Markusen (1997) added to the literature by focusing on factor proportions in a two factor model economy. Also, a rich environment of different types of FDI was included. Solving these and subsequent models by simulations provided insights into the relationship between FDI and factor proportions,[4] i.e. how differences in factor proportions favor different types of FDI.[5]

A recent review of empirical studies searching for determinants of FDI can be found in Blonigen (2006). He broughtly groups these into two categories. Firm level studies trying to find correlations between firm specific characteristics and firm specific FDI behavior and more macro economic oriented general equilibrium studies trying to find correlations between country or region characteristics or exogenous macro economic variables and FDI inflows. Firm level studies point to the importance of own intangible assets and access to other's intangible assets as well as firm size and productivity (Helpman et al., 2004). Macroeconomic general equilibrium studies point to the importance of exchange rates, taxes, uncertainty, agglomeration effects and tariffs as noted by Markusen and Maskus (2001).

It seems remarkable that capital is absent in almost all the papers and articles cited above, the only factor of production considered by these models is labor. Also the issue of heterogeneity in factor substitutability and the interest rate seem to be hardly recognized by the literature on FDI.

The model below therefore aims to add to the theoretical literature on determinants of FDI by taking account of the difference in the elasticity of substitution between capital and labor across developed and developing countries. The case analyzed in this paper is that of a falling real interest rate over a longer period of time and a thereby induced increase in the capital/labor ratio, i.e. capital deepening. The lower degree of substitutability of capital and labor in developing countries implies, ceteris paribus, a slighter increase in the capital/labor ratio. However, different products in the model are not perfect substitutes and the declining relative capital/labor ratio in the developing country induces increasing prices for goods produced there. This counteracts the above effect and can even dominate it, inducing convergence between countries. Therefore either a U-shaped or an inverted U-shaped relationship between the capital/labor ratio of the developed country and the relative capital/labor ratio of the developing country emerges. There are two kinds of investments analyzed in this paper. The first is portfolio investment by which investment flows by ordinary investors are meant which are subject to local productivity in creating capital goods for production. The local relative productivity is assumed to be lower in the developing country. The second is foreign direct investment originating from the developed country which refers to the situation where a particular firm can create its on capital goods for investment abroad by using its relatively higher productivity. The aforementioned profile in the relative capital intensity of the developing country drives a wedge between the marginal product of portfolio and direct investments which causes initially always FDI profitability to rise and later on eventually to fall.

Desroches and Francis (2007) among others have documented that during at least the last 15 years the real interest rates in developed countries were falling. During the same period of time FDI inflows around the world grew heavily (see e.g. Unctad, 2006) by more than GDP did. Also this evidence might be only suggestive, the paper might be of general interest because a falling interest rate accompanied with a rising capital intensity are the general characteristics of the adjustment process to a steady state in the growth process of an economy (see e.g. Barro and Sala-i-Martin, 2003).

The basic framework is somewhat similar to the one presented in Helpman (1985) where differentiated products can be produced by MNEs either in the home or the host country and are sold simultaneously in both markets. Helpman (1985) terms this as "horizontally integrated multinationals" but Markusen and Maskus (2001) point to the difference of this setup to what is usually referred to as horizontal FDI.

The model in this paper does not aim to give a contribution on the question why horizontal FDI between similar countries occurs. Instead the focus is only on different countries motivated by the observation that less developed countries poses a lower elasticity of substitution between capital and labor. Exactly this observation is the motivation for this paper and, hence, this paper elaborates on isolated effect of this difference which can only be observed between different countries on FDI flows.

The model thus fits more into the category of early contributions to the FDI literature which tries to explain FDI behavior by differences in factor proportions starting with the contribution of Helpman (1984).

The paper is structured as follows: Section 2 below develops the production function used in the model in Section 3 and the last section finally concludes.

2. Theoretical background

The CES function developed in Arrow et al. (1961) as a solution to the partial differential equation defining the constant elasticity of substitution

[3] Horizontal FDI corresponds to the situation where a firm serves the foreign market by producing the final good in an own foreign facility, whereas vertical FDI means that intermediate input factors for production of the final good are produced in an own foreign facility. Export platform FDI involves production in a foreign country to serve other countries with products.

[4] Factors that are recognized are skilled and unskilled labor, capital however is not present in these models.

[5] The knowledge capital model was subsequently tested empirically in Carr et al. (2001,).