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Optimal tax policy and foreign direct investment under ambiguity

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ABSTRACT

We analyze the optimal timing of an irreversible foreign direct investment by a foreign firm and the optimal tax policy by a host country under *ambiguity*. We derive the optimal GDP level at which the foreign firm switches from exporting to a foreign direct investment. Furthermore, we derive the optimal tax policy by the host country, and analyze the effect of an increase in ambiguity on the optimal tax policy. We show that the host country should reduce the optimal corporate tax rate from the host government's perspective in response to an increase in ambiguity. Our result is different from the one obtained by Pennings (2005) that shows that an increase in risk induces an increase in the optimal corporate tax rate.

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1. Introduction

Suppose a firm that considers whether to export her product to a host country or to enter the market by undertaking a foreign direct investment (henceforth FDI). Compared with domestic markets, it can be considered that foreign firms that aim to enter foreign markets are faced with more uncertainty about the prospect of foreign markets than that about the prospect of their own domestic markets since economic and political stability in foreign countries cannot be easily predicted. Since uncertainty about the prospect of foreign markets directly leads to uncertainty about the prospect of profits earned in the host country, it can be considered that uncertainty has a negative impact on FDI. As pointed out by Aizenman and Marion (2004), when we analyze FDI, focusing on uncertainty is important since (1) in general, host countries of FDI are developing countries, and (2) business in developing countries is considered to be more uncertain than that in developed countries. Thus, if greater uncertainty has a negative impact on FDI from developed countries, then it might deter economic development in developing countries, which implies that developing countries should adopt policies to encourage FDI.

Aizenman and Marion (2004) analyze the impact of risk in vertical and horizontal FDI.[1] Based on data on US multinational firms (US Bureau of Economic Analysis), Aizenman and Marion (2004) find empirical evidence that (1) risk has a negative impact on FDI, (2) risk has a greater negative impact on vertical FDI than horizontal FDI, and (3) risk has a negative impact on corporate taxes, which implies that a lower corporate tax significantly increases FDI. On the other hand, Pennings (2005) analyzes effects of increases in risk on host country's corporate tax rate, and shows that an increase in risk increases the corporate tax rate. This result neither conforms to Aizenman and Marion (2004)'s empirical result nor our intuition that when firms are more uncertain about the prospect of foreign markets, they are reluctant to undertake FDI, which makes host governments reduce their

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[1] As in Aizenman and Marion (2004, p.126), vertical FDI is adopted when multinational firms fragment their production processes internationally and locate each stage of production in the country in which it can be produced at the least cost. Horizontal FDI is adopted when multinational firms produce the same product or service in multiple countries.

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corporate taxes to encourage FDI.[2] The purpose of this paper is to generalize the notion of uncertainty to the notion of *ambiguity*, which is distinguished by *risk*, and to show that the host government should reduce the optimal corporate tax rate from the host government's perspective in response to an increase in ambiguity.[3]

The importance of the distinction between risk and ambiguity is pointed out by Ellsberg (1961), which provides some evidence that people tend to prefer to act on known rather than unknown or vague probabilities. Uncertainty that is captured by a set of probability measures is called *Knightian uncertainty* or *ambiguity*. On the other hand, uncertainty that is captured by a unique probability measure is called *risk*. Ambiguity can be analyzed within the framework of the Maxmin Expected Utility (henceforth MMEU). MMEU axiomatized by Gilboa and Schmeidler (1989) in order to overcome the Ellsberg paradox states that if a certain set of axioms is satisfied, then decision maker's beliefs are captured by a set of probability measures and her preferences are represented by the minimum of expected utilities over the set of probability measures. MMEU has deepened our understanding of decision maker's behaviors under ambiguity. If foreign companies are assumed to be less confident about the prospect of economic and political stability in host countries and they are assumed to make decisions very cautiously, then their decisions can be well analyzed within the framework of MMEU. Therefore, this paper adopts a continuous-time model of ambiguity proposed by Chen and Epstein (2002) in order to provide an economic foundation for tax policies adopted by host governments that aim to encourage FDI.[4]

We consider a situation in which a foreign firm must decide whether to export her product to a host country or to enter the market by undertaking an *irreversible* FDI under ambiguity.[5] In this paper, FDI is irrversible in the sense that once the foreign firm decides to shut down her plant at the host country, the cost of the plant cannot be recovered when she switches to exporting. For the evolution of the GDP level in the host country, we assume that the evolution follows a geometric Brownian motion. Contrary to the standard model in which the evolution of the GDP level is characterized by a geometric Brownian motion based on a single probability measure, we assume that the firm is not perfectly confident about the evolution of the GDP level. In other words, the firm is faced with ambiguity in which her beliefs are characterized by a set of probability measures, not by a single probability measure and her preferences are represented by the minimum of expected utilities over the set of probability measures.

We provide four specific models in Sections 3 and 4. In Sections 3.1 and 3.3, we consider Nash bargaining situations under risk and under ambiguity where the foreign firm and the host government jointly maximize their present values of benefits, and we derive the critical GDP level, the optimal corporate tax rate and the optimal subsidy to the cost of investment. These outcomes correspond to efficient solutions to a social planner. In Sections 3.2 and 3.4, we consider non-cooperative situations under risk and under ambiguity in which the foreign firm and the host government maximize their own present values of benefits, and we derive the optimal GDP level, and the optimal corporate tax rate. In the non-cooperative situations, taxation by the host government leads to a double marginalization problem. This is because the firm requires a mark-up over the cost of FDI and the host government charges a mark-up over the required after-tax payoff to the firm.

We show that an increase in ambiguity induces a decrease in the value of undertaking FDI, and that an increase in ambiguity induces a *decrease* in the optimal corporate tax rate from the host government's perspective. The first claim implies that the negative impact on the value of undertaking FDI makes the firm become more cautious about FDI than before and makes the firm postpone FDI. The second claim states that the host government should reduce the optimal corporate tax rate in response to an increase in ambiguity in order to encourage FDI by the foreign company that is reluctant to undertake FDI and is less confident about the evolution of the GDP level. Furthermore, the second claim also implies that the more ambiguity the foreign company has about the prospect of the GDP level, the greater is the incentive for the host government to reduce the optimal corporate tax rate than to increase. Our results are different from the ones obtained by Pennings (2005) that shows that an increase in risk does not affect the value of undertaking FDI, and that an increase in risk induces an *increase* in the optimal corporate tax rate from the host government's perspective.[6]

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[2] In the literature on real option, risk is captured by volatility, which implies that volatility has both negative and positive effects on profits. Therefore, it could be considered that Aizenman and Marion (2004)'s empirical results capture this negative effect on profits. This implies that an increase in risk induces a decrease in the corporate tax rate.

[3] Mackie-Mason (1990), Hasset and Metcalf (1999) and Pennings (2005) analyze effects on investment of uncertainty about tax policy. Mackie-Mason (1990) and Hasset and Metcalf (1999) consider exogenous taxation, whereas Pennings (2005) and this paper consider endogenous taxation.

[4] In static frameworks, Ghirardato et al. (2004) and Klibanoff et al. (2005) provide more general models than MMEU in which MMEU is derived as a special case. Klibanoff et al. (2009) generalize Klibanoff et al. (2005)'s model into a dynamic but discrete-time infinite horizon framework. In this paper, we adopt a continuous-time model of ambiguity proposed by Chen and Epstein (2002) in order to analyze behaviors under ambiguity within a continuous-time framework. For applications of Chen and Epstein (2002), Epstein and Miao (2003) analyze the home bias puzzle with the presence of ambiguity in general equilibrium settings, and show that the puzzle can be resolved by incorporating ambiguity. Nishimura and Ozaki (2007) first introduce the concept of ambiguity into real option and analyze an optimal investment problem under ambiguity. Based on Nishimura and Ozaki (2007), Asano (2007) analyzes optimal environmental policies under ambiguity.

[5] In this paper, we assume that a foreign firm determines the timing of switching from exporting to FDI when the host country's GDP level reaches a certain critical level. Within our model, the GDP level and the firm's profitability are positively related. Thus, the firm's problem can be formulated as follows:the firm's problem is to determine the timing of switching from exporting to FDI when the profit of undertaking FDI reaches a certain critical value. Contrary to our model, Pennings (2005) assumes that the foreign firm's decision depends on the growth rate in households. See footnote 9.

[6] In the literature on real option, it has been widely accepted that an increase in risk has a negative impact on critical values of optimal investments. Sarkar (2000) and Wong (2007) analyze the effect of risk on investment timing in a canonical real option model within the framework of the single-factor intertemporal capital asset pricing model. Wong (2007) shows that an increase in risk induces an increase in the critical value of the optimal investment for relatively high levels of risk. Wong (2007) also shows that an increase in risk induces a decrease in the critical value of the optimal investment for relatively low levels of risk. On the other hand, Nishimura and Ozaki (2007) analyze the effect of ambiguity on investment timing within the framework of MMEU, and show that an increase in ambiguity induces a decrease in the critical value of optimal investments.

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