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A SIMULATION-BASED MODEL OF TECHNOLOGY LOCALIZATION IN DEVELOPING COUNTRIES

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ABSTRACT

Technology localization is a popular policy in developing countries to reduce the dependency on foreign partners of the industrial manufactures. In this paper, we present a model to analyze the determinant parameters of technology localization process. The model is based on the system dynamics methodology. Our results show that the technology localization becomes stable after a period of time.

1 INTRODUCTION

Many experts believe that developing countries need to replace innovation and indigenous development with imitation and learning for some time. However, imitation implies proper understanding and learning of the imported technology which can lead to gradual innovative changes in the technology. The process of importing technology and adjusting it with regards to the economic, social, and political conditions of the destination country is called technology localization. In this process, other parameters such as natural and human resources, climate, and many other factors play important roles. In this paper, we introduce and analyze several variables that affect the rate of technology localization in a developing country.

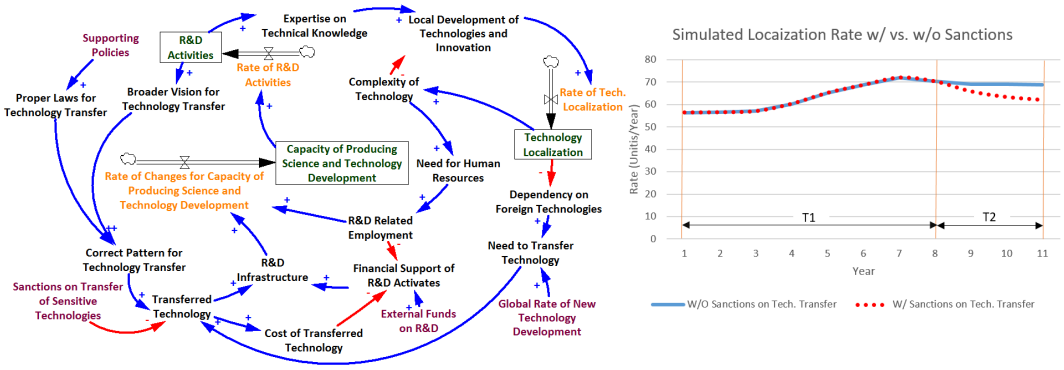
2 MODEL

The main variable in this problem is the rate of technology localization. Technology localization has different steps such as: the ability of utilizing the technology, making minor and major changes, innovation, and mastering the fundamental knowledge of the technology. Other important variables include technology transfer, dependency on foreign countries, and research and development (R&D). Our approach is based on a system dynamic model where the whole model is reduced to a system of ordinary differential equations that are solved numerically with Runge-Kutta method(Rafieisakhaei, Barazandeh, Bolursaz, and Assadzadeh 2015, Rafieisakhaei, Barazandeh, and Tarrahi 2016, RafieiSakhaei and Jabbari 2012).

As shown in Fig. 1a, higher technology localization lowers the dependency on foreign countries to import new technologies. That leads to a higher investment on the R&D which rebuilds and develops its infrastructure. As a result, the capacity of technological development and the R&D activity enhance. This has two effects; first, it increases the expertise on technical knowledge; second, through improved vision on the technological aspects, a more appropriate model for technological transfer is achieved. Both of these effects lead to a higher rate of technology localization. On the other hand, a more localized technology means having to adopt more advanced technologies. This acts as a balancing loop to slow down the pace of localization (Rafieisakhaei, Barazandeh, Moosavi, Fekri, and Bastani 2016b, Azadeh, Fekri, Asadzadeh, Barazandeh, and Barrios 2016, Rafieisakhaei, Barazandeh, Moosavi, Fekri, and Bastani 2016a, Rafieisakhaei, Barazandeh, Moosavi, and Bastani 2016).

3 SIMULATION RESULTS

We simulated the stock and flow model in Vensim PLE software. As shown in case one of Fig. 1b, our results show that the rate of technology localization increases rapidly in the beginning and reaches its peak



(a) (b)

Figure 1. (a) Localization model, (b) localization level simulation for cases with and without sanctions on technology transfer.

value after a certain time. After that, the technology localization grows with a slower rate. In case two of Fig. 1b, we investigate the introduction of sanctions on transfer of sensitive technologies, which results in a reduction of localization rate, due to the limited access to the state-of-the-art technologies.

4 CONCLUSION

In this study, a system dynamics model was introduced in order to analyze the effects of different variables on the technology localization in developing countries. Our results show that technology can be localized with a higher rate in the beginning of the process for a certain period. Then, the localization process continues to grow with a slower rate due to higher technological complexities. Moreover, improvement policies such as innovation, education, and connection with the original source have a significant positive effect on the amount of technology localization. Our future work analyzes different aspects of the model.

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