Abstract: There are numerous empirical research about the effect of foreign direct investment (FDI) on technology spillover in China which are not unanimous in their results. This paper, by using meta-regression analysis, blends, explains and finally summaries almost all the recent published empirical literatures on the effect of FDI on technology spillover in China in industry level for the period of 1995 to 2013.

This paper is part of my master thesis which is not completed yet, however; I have determined outline and the methodology I will use during my research. In this meta-regression analysis, we will regress study estimates of spillover on some study characteristics in order to find out the direction and significance of FDI’ spillover. Although we haven’t got the result now, our hypothesis is that, factors including degree of freedom, different estimators, types of FDI and estimation period should have significant effect on the final estimates.

Keywords: foreign direct investment (FDI), meta-regression analysis, China
0- introduction

FDI has negative and positive effects on Chinese economy. There are vast literature and empirical studies about FDI effects. Technology spillover, management skills, improving human capital and increasing in investment, GDP, productivity and exports are some of major effects of FDI in China (Buckley et al., 2007; Madariaga & Poncet, 2007; Chang & Xu, 2008).
China benefited a lot from presence of foreign companies by the increase in productivity, educational level, value-added, exports and investment since 1990s. Although, wages didn’t rise according to productivity growth and income inequality deepened in this period; yet, the whole economy constantly improved (Chen et al., 2011).

According to China National Bureau of Statistics, foreign companies in China are divided to foreign founded companies and overseas Chinese companies that include companies from Hong Kong, Macao and Taiwan which invested in China. FDI from overseas Chinese companies always had more than 50 percent share of FDI in China; this rate reached to more than 63 percent in 2011 (China Statistical Yearbook, 2012).

Some studies regarding FDI effect on China have found positive effects and some others, have found negative or no effect at all.

Here, in this paper which is part of my master thesis, we will mix all these different results together.

In our meta-regression analysis, we will regress study estimates of spillover on some study characteristics in order to find out the direction and significance of FDI’ spillover.

Up to now we have collected our data and we are coding them.

In this (unfinished) paper I’ve explained what we have done up to know and what we are going to do for the rest of process. We also have mentioned what Meta-analysis model we are going to use in order to do so.

In first part after this introduction, We have talked about FDI in China, trends and history and government policies, then in part 2, is literature review for both, FDI spillover in China (previous studies) and Meta-Analysis of technology spillover from FDI (previous meta studies). After that, in part 3, designing a Meta-analysis regression is discussed. As I said conclusion is to be determined by the end of our research.

1- Technology spillover from FDI in China
Increasing foreign direct investment (FDI) has always been a concern for economic growth, mostly in developing countries that are usually suffering from lack of domestic investment. Regarding this China is considered a successful example.

China which is my case study in this paper seems to be a perfect example for analyzing spillover from FDI for several reasons. For one thing because Chinese government has recently stimulated FDI to support backward industries and for another thing because it has just changed from a Communist economic system to a liberalized market economy so it is true to say that, there are lots of small and big firms with lots of capabilities (Sea Jin Chang et al., 2007) in addition, from 1993 China has been the biggest developing country, hosting FDI.

Since late 1970s that China started its economic reform, the amount of FDI in China has incredibly increased. The amount FDI inflow in China at the beginning of its economic reform in 1979 was less than $100 million but this amount was over $258 billion in 2014 which means its annual growth rate is almost 30%.

In manufacturing industries that have attracted the most amount of inward FDI in China, FDI has exceeded almost 60% from 1996, however this ratio dropped by about 10% due to Asian Financial Crisis during 1997-98. This ratio again increases when China joined WTO by 70% in 2004. Interesting point here is that China’s government made the same reform for income tax for foreign firms as it did for domestic one in 2006 (Lili, 2010)

Figure 1 perfectly shows amazing speed of FDI increase in China after its economic reform. By taking a closer look on China’s government policy, we find out that this sharp increase in FDI inflow comes shoulder to shoulder with encouraging government policies of FDI. Hale suggests that the majority of these policies are aimed at evening up operating circumstances for foreign capital inside and outside of China and some are also are providing monetary incentives for foreign investors (Hale et al., 2007).
However China’s FDI growth and government policies’ contribution to it is undeniable, there is no unanimous opinion on the influence of FDI on firms inside China though bunch of studies on FDI effect on productivity and technology spillover has come to a wide range of results that shows how and under which conditions domestic country can benefit from technology spillover from FDI.

It is widely believed that FDI leads domestic firms to improve their productivity besides technological efficiency as long as they are benefiting from technology spillover from FDI. Foreign firms cannot measure the value of this benefit to host country, due to this reason this spillover is usually called “involuntary technology transfer” or “spillover effect” by Kokko (1994). Trends of FDI inflow to China is easily recognizable if we take a look on changes in policy directions in last decades: the first stage from 1979 to 1984, the second one from 1984 to 1992 and
the last one from 1992 to 1999 (OECD, 2000), which we can expand the last stage up current time since China’s policies’ direction hasn’t changed.

As for first and second stage, China by establishing its first four Special Economic Zones (SEZs) in 1979 and opening its 14 coastal cities in 1984 and afterward its interior provinces to welcome FDI, has been highly successful in attracting FDI in different ways. Henley claims in 1997 around 200 world’s largest multinational companies out of 500 were active in China. FDI inflow from its smooth rate in 1980s accelerated clearly in mid-1990 which also was stimulated by reforms, introduced by the late Deng Xiaoping (Henley et al., 1999)

Third steps start by the Xiaoping visiting China’s southern coastal areas and SEZs which was aimed to improve Chinese reform policy and its commitment to open door policy. In this stage China embraced new policies not only following a nationwide implementation of open policies for FDI. The amount of FDI inflow in 2013 are proof that the third stage was a great success (OECD, 2000).

b. Government policy

A growing number of governments, around the world want to increase the inflow of FDI into their country since they have found out that it helps to improve their country in different aspects. They believe that the positive effects of FDI (i.e. poverty reduction, Technology spillover, growth and etc.) overweight negative effects (i.e. inequality, weakening trade union, crowding out effects and etc.). A country’s FDI strategy is determined based on all these positive effects from FDI as well as the level of factor endowment and also the ability to choose the level of policy intervention, after finalizing the FDI strategy they have a range of FDI policies affecting FDI (Dirk Willem te Velde 2001).

In two and half past decades China has passed a wide and almost complete range of laws and regulations regarding foreign direct investment, which include the law of People Republic of China for Wholly owned enterprises, Sino Foreign Joint venture and etc. those regulations also include several preferential policies for China’s SEZs. As said whatever China is doing, is aimed to attract as much favorable FDI as possible. Consequently Foreign Invested Enterprises (FIEs) depends on the region and their industry really benefit from preferential treatment when we compare with domestic ones. In addition to this, China has called several part of the country as special economic area which every single of them is under a different set of rules and regulations. Besides, China has applied two policies which are called “Strategy of Reviving Industrial Bases” and “West at
Full Blast” in order to canalize FDI toward northeast and west part of the country. These two policies provide foreign enterprises even with more benefit from preferential treatments. For China's government industrial guidance on FDI weights more. According to Guoqiang Long (Theodore H. Moran et al. 2005-Chapter 12) by Guiding Directory, various preferential treatment were determined, granted especially for multinational enterprises in different industries. Guiding Directory has changed and improved twice. First December 1997 and second time, April 2002 due to China’s accession to WTO. It actually creates for classification for FDI involving projects. First category includes projects which were encouraged, the second group those which are just allowed and third and fourth limited and forbidden ones. Concurrently China is utilizing FDI for these goals:

- To modernize traditional agriculture and to improve the modern agriculture.
- Some basic industries, including infrastructure for transformation raw materials and energy sources.
- As mentioned before developing industries in western part of China.
- Using more renewable resources as well as stimulating environmental protections policies.
- China is strongly motivating foreign multinational businesses and firms to use more advanced technology with the aim of improving some traditional industries likewise textile and consumption goods manufacturing industries.

Before China joining WTO, it had had some more restricted FDI rules including performance requirement but due to WTO membership requirement China had terminate some and modify some others of its FDI rules.

2- Literature review
   a. Technology spillover from FDI in China (previous studies)

Almost after 1990s increasing amount of inward FDI to China has attracted lots of attention to it. Hence lots of studies have tried to analyze technology spillover from FDI in Chinese industries. Quite huge number of theoretical studies have estimated positive effects of FDI on Chines economy while when it comes to empirical studies, result are not that much unanimous.

The model (firm-level, panel data) which is mostly used in recent papers in order to find if there is a significant effect from FDI on productivity or simply to find out if there is technology spillover from FDI in host country or not, is:
\[ \ln \text{Prod}_{xy} = \beta_1 hF DI_y + \beta_2 b ackF DI_y + \beta_3 f orF DI_y + \beta_4 Conts + u \]

Where:

\( \text{Prod}_{xy} \): is productivity of a firm \( x \) in sector \( y \).

\( h\text{FDI}_y \): is the number of foreign firms over domestic firms in sector \( y \).

\( \text{ba} \text{ckFDI}_y \): is the number of foreign firms over domestic firms (the ratio which is between 0 and 1) in different sectors which buy their intermediate goods from firms in sector \( y \) (Backward FDI).

\( \text{forFDI}_y \): is the number of foreign firms over domestic firms (the ratio which is between 0 and 1) in different sectors which sell their intermediate goods to firms in sector \( y \) (Backward FDI).

In some studies control variables are used to have a better estimation of productivity, all those control variables are included in \( \text{Conts} \) variable.

Studies of positive spillover from FDI in China can be divided into three groups based on the level of data they have collected. Some authors mainly focus on the firms, some others mainly on the industry and some others in provincial level. Some argue if there is enough absorptive capacity, then FDI will encourage economic growth in host country (Borensztein et al., 1998; Balasubramanyam et al., 1996) and through different sectors (Sjoholm, 1999) and different firms (Aitken and Harrison, 1999; Girma, 2003).

One of the earliest studies in this field is Borensztein et al. (1998) that argues FDI can have some positive spillover if there exist at least minimum amount of human capital in host country. Following that, Sjoholm (1999) suggests there is positive relation between positive spillover from FDI and how competitive the sector is, the degrees of completion has direct influence on the type of technology which is transferred from MNEs in host countries.

Some later studies suggest, different source of FDI can bring different type of positive spillover. For instance Banga (2003) study shows that FDI inward to India from Japan has got more positive spillover than FDI inward to US from Japan and there reason simply is there are differences in the type and technological level of technology in US and India and how Japanese technology transfer into these countries.

Some others believe technological diffusion of foreign firms is also limited by geographic features meaning as distances increase spillover decrease (Audretsch, 1996) and the reason is different ways that technology can be transferred are prepared in regional level (Crespo and Fontoura, 2007), for instance one important channel through which technology is transferred is employment
training and we know that labor mobility is not so much in this regard (Greenaway et al., 2002) so the benefit from training and existence of MNEs will be experienced only by area close to firms. Last but not least, a few authors have mentioned that technological transfer is affected by macro-economic conditions not only in host country but also in parent’s country (i.e. and Yudaeva et al. (2003), Sgard (2001) and Jordan (2008)). For instance, in these papers, it is mentioned that there is a positive correlation between the level of labor’s education, development level in both host and parent county and technology spillover from FDI.

b. Meta-Analysis of technology spillover from FDI, previous studies

Gene Glass (1976) was the one who coined the phrase Meta-analysis and he defined this term as “The statistical analysis of large collection of results from individual studies for the purpose of integrating the findings. It connotes a rigorous alternative to the causal, narrative discussion of research studies that typify our attempt to make sense of the rapidly expanding research literature” (Glass 1976:3).

Recently there are lots of studies using this approach in different fields mostly in social sciences. Economics is not an exception. There are several studies available using meta-analysis approach to assess spillovers from FDI as well. In order to date of publication they are: 1- Görg and Strobl (2001) 2- Meyer and Sinani (2009) 3- Wooster and Diebel (2010) 4- Havránek and Iršová (2012a) 5- Mebratie and van Bergeijk (2013)

Görg and Strobl (2001) was maybe the earliest study in this field, analyzing the effect of study design on the spillover from FDI. The dataset they used, consist of 25 observations from 21 empirical studies. Their main argument was the spillover from FDI can be influenced by the way the author define the existence of FDI. By the other words, variables indicating presence of FDI in a country can bring some bias in the results. In addition they also suggest, studies using cross-sectional data will probably report higher amount of spillover than panel data studies. Lastly, they found some publication bias meaning, those studies that have found a statistically significant result are more likely to be published.

After Görg and Strobl, next study is Meyer and Sinani (2009), using a dataset of 124 observations from 66 empirical studies. They collected these data from developed countries, developing countries and transient economies. They concluded that availability of cross-sectional versus panel
data analysis and firm-level versus industry-level data will determine the variance of technology diffusion in a cross country level.

After Meyer and Sinani a more recent study by Wooster and Diebel (2010), look for the relation between research design and spillover result. Their study which they have used a dataset of 141 number of observation from 32 empirical studies (just developing countries) conclude that by using different proxy variable, spillover results vary considerably. They also suggest that, omitted variable bias in studies can lead to mixed spillover effects.

Finally three recent studies in that era are Havránek and Iršová (2012a), Mebratie and van Bergeijk (2013) and Randolph Luca BrunoMaria Cipollinaand (2014). Each one choosing studies after 2000 and also they mostly refer to a selection bias introduced by meta-analysis itself.

3- Designing a Meta-analysis regression
   a. Our database

we searched for empirical studies on FDI spillovers in the EconLit, Scopus, and Google Scholar databases, searching for some keywords such as “FDI”, “spillover”, “China” and “technology”, besides we have these criteria as well, 1- papers written in English 2- papers using firm level data and 3- time period. finally we built a dataset consist of 29 papers published after 2004, including academic journals, unpublished studies, dissertation, book chapters and working papers giving us about 132 regression results.

   b. Combined significant

After collecting our data (spillover from FD, firm level data), there is one question that must be answered: is it possible to say there is spillover from FDI in China from these studies or not? By the other words is it correct to take the huge number of positive significant results of different studies as a representing variable of existing spillover? Actually the answer is no, since different researchers use different units, then it’s not correct to consider the magnitude of estimations as a corresponding variable. Instead we can use t-statistic which is widely used for purpose of meta-analysis as well (it is used also by 4 studies before i.e. Wooster and Diebel, 2006, Meyer and Sinani, 2005). There are several possibilities using t-statistic to calculate combined significant. The first one is called “vote-counting method” (see Hunter and Schmidt, 1990 for more explanation). This approach suggests to use median value of the t-statistics of the sample. If the median is statistically significant then it means we can take it is an evidence of existing spillover
from FDI. Although this method was criticized by Djankov and Murrell (2002), and was almost replaced by second approach in which a new t-statistic is defined:

\[ T = \frac{\sum_{k=1}^{K} t_k}{\sqrt{K}} \]

Where \( k \) is the number of studies in meta-analyses and \( t_k \) is the \( t \) of \( k_{th} \) model in our sample. Having said that different studies in meta-regression are not correlated and usually have got enough number of observations (then degrees of freedom), we can say \( T \) is normally distributed and this way, combined significant can be easily tested (Zuzana Iršová, Tomáš Havránek, 2010). We use second approach in our paper to check for significance of \( T \).

c. Methodology and variables

We will follow Görg and Strobl (2001) and recently, Diebel and Wooster (2006) and use following model in order to run Meta regression analysis on 32 samples which looked for FDI spillover in China. From each single study we will take t-statistic of the coefficients for the FDI variable. After that we will regress t-statistic variable on several study characteristics that are meta-independent.

\[ y_n = \alpha + \sum_{l=1}^{L} \beta_1 X_{nl} + \varepsilon_n \quad \text{and} \quad k = 1, 2, ..., K \]

Where; dependent variable, \( y_n \) is the t-statistic from \( n_{th} \) study and our explanatory variable, \( \sum_{l=1}^{L} \beta_1 X_{nl} \) are the meta-independent variables which have the characteristics of the empirical studies in the sample, which will explain changes in t-statistics in different studies. The variables included are: Measure of FDI, the response variable (output or productivity in levels or growth rate) and control variables included in the regression (capital, labor quality, industry, firm and time dummies).

4. Conclusion

To be determined by the end of our research.
5- References


Sea Jin Chang & Jaiho Chung & Dean Xu. (July 2007). “FDI and Technology Spillovers in China”


