Innovation and knowledge spillover: insights from the Ethiopian manufacturing industry

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Abstract: Knowledge plays a key role in technological advancement and structural transition. However, many manufacturing firms, especially in developing countries, struggle to source and reap the benefits of knowledge. Using a dual study approach of manufacturing firms in Ethiopia, this paper suggests that a strong national innovation system that facilitates knowledge spillover is important. The paper also suggests that joint venture, subcontracting, and cluster-based industrial development are alternatives to promote knowledge spillover, which in turn, strengthens knowledge transfer activities, especially technology-related knowhow, in developing countries. This, in turn, empowers manufacturing firms, especially in developing countries, to catch up and leap front to industry 4.0.

Keywords: innovation; knowledge management; structural equation modelling; SEM; knowledge spillover; manufacturing firms.

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1 Introduction

Innovation is an important concept for business today (Abdel-Razek and Ubaid, 2019; Liau et al., 2019; Lim, 2019a) and crucial to innovation is knowledge management (Al-Hemyari, 2019; Mishra and Rane, 2019). In essence, innovation is a reflection of the creativity and originality of the creator to produce something new (Lendel et al., 2017). The produced ‘new’ may also represent creators’ path-breaking activity (McFarling, 2000). Thus, along the path, up and downs, obviously existed representing success and failure story of the creator firm. Consequently, the creators’ path towards newness has defined by a pattern showing creative destruction for firms not innovative before and creative accumulation patterns created by already innovative firms (Breschi et al., 2000). The pattern used as an indication for firms’ ability to become more flexible and responsive to any new circumstances (Boschma, 2005). Such kind of responsive flexibility implies firms’ capability in exploration as well as the exploitation of new knowledge (Vandenbempt and Berghman, 2006). The exploitation and exploration process expressed as a detailed activity of firms’ involvement in knowledge-gathering, knowledge transformation and knowledge exploitation activities (Roper and Arvanitis, 2012). That detail activates of creator firms for innovation known as a process of knowledge management (Tálamo, 2008; Tidd and Bessant, 2018; Tidd and Bodley, 2002). Thus, at this point, it should be clear that knowledge management is a starting point of innovation. Further, for firms that existed in the 21st-century competition starts with the ability to manage that bulky and diverse information existed across the globe. Thus, the extent of performance on combating competition then depends on the strategic relation of firms with the role of knowledge management and competitors’ (G. Gupta et al., 2018). As the study of G. Gupta et al. (2018) showed information can be sourced from internal and external domains and its acquisition, integration, and usage depends on firms’ control. Thus, firms capable of managing information create knowledge through absorptive capacity and enhance their innovation capability (Cohen and Levinthal, 1990). Especially startup firms involved in cluster formation and flagship entrepreneurship activities are seen creating an opportunity to collect knowledge spillover even from the competitors (Anokhin et al., 2019). Moreover, firms active in managing sourced knowledge spillover has also created a capability to increase the quality of collaboration across firms and in related industries (Audretsch and Belitski, 2020). Therefore based on Audretsch and Belitski finding controlled knowledge spillover and internal knowledge investment (R&D) can determine how innovation has been achieved. However, achieving knowledge through R&D requires massive investment, which for startup firms located in developing countries it becomes a critical challenge of creating a breakthrough innovation (Anokhin et al., 2019).

Lendel et al. (2017) found the process of introducing new technologies into the world is rapid and dynamics. Moreover, the process of hurried technological development in the entire world is mostly facing social and cultural resistance. Typically when it comes into innovation, the deadlock resistances occur when articulated public ambitions do not match with the actual ability or willingness to act (Grotenbreg and van Buuren, 2018). In this respect, Kim (1997) proves in his research that, economically weak countries cannot pass those innovation hurdles and combat international competition unless nations start to have a different policy set up. Specifically in his book titled *Imitation to Innovation: The Dynamics of Korea’s Technological Learning* concludes that developing countries should start with the idea of imitation on technologies which have already developed rather than investing in R&D for a new invention. A study done by Kale and Little (2007) confirms Kim’s work in the Indian Pharmaceutical industry, which follows a particular Kim capability creation model and demonstrates how this particular industry projected from imitator to innovative R&D frontier.

However, such kinds of policy shifts do not seem an easy task. However, it needs the collaboration of all concerned stakeholders. According to Scerri and Lastres (2012) the existence of stakeholders, with their contribution, and process of contribution proofs the requirement of the innovation system. Specifically, the process of contributing dictates stakeholders' relation with their production, assimilation, use, and diffusion of knowledge.

Thus, managing knowledge spillover has considered in the literature as a cornerstone for firms hindered by innovation capability problems and cannot perform in-house R&D investments. However, till, now there are no clear cut boundaries and strategic sources of knowledge spillover, which can fit the actual situation of firms located in developing countries. Thus, this research investigated a detailed strategic source of knowledge spillover variables, which needs policy implications for their actual influence in the success of innovation. Besides, the research also investigated the actual practice of manufacturing industries in Ethiopia in their process of acquiring knowledge and use external opportunities during their innovation practices.

2 Literature review

Manufacturing firm's followed a knowledge-based manufacturing system that has a strong strategy found through cooperation and the sharing of knowledge (White et al., 2013). Following such kind of strategies, the study of White et al. (2013) confirmed that nearly all developed countries are transitioning into knowledge-based economies. Similarly, developing countries has also a chance to enter into a knowledge-based economy accepting the argument that competition is characterised by the strength of strategies targeting a knowledge-based economy (Wixted, 2009). As literature, confirmed knowledge-based manufacturing system has characterised as a transitioning from labour-intensive manufacturing into a knowledge management system. Thus, the new transition is known as knowledge management process (KMP).

The critical question for firms started their transition from scratch will be then where is the source of KMP? The sourcing could be from internal pure R&D[1] done by firms' direct involvement to generate pure and applicable knowledge by their effort. However, for developing countries, such practice is almost impossible and sourcing knowledge from external sources becomes common practice. Consequently, firms that existed in developing countries search for implemented knowledge elsewhere in different forms, which has called knowledge spillover. Hence, the discussion of innovation then circled the forces of strategic variables that transform labour-intensive manufacturing processes into the knowledge-based manufacturing process. It implies that a knowledge-based manufacturing process (KMP) is a starting point innovation besides it starts seeking knowledge from different sources. Similarly, the seeking of knowledge in different forms then revealed by strategies and policies designed to be open the boundaries of innovation system through cooperation, and co-creation approaches (Zerwas, 2014).

As the study of Lichtenthaler and Lichtenthaler (2009) indicates open innovation strategy is expressed by the process of absorbing knowledge from external sources and managing knowledge overtime. In another view, open innovation strategy required to entertain co-creation (De Koning et al., 2016) or collaboration (Greer and Lei, 2012;

Lane and Lubatkin, 1998; Lichtenthaler and Lichtenthaler, 2009; Ramadani et al., 2018) as a core driving force into an innovation success.

The study of Spanò et al. (2017) confirmed successful organisational changes into a knowledge-based manufacturing system initiated when innovation activities favouring informal and formal collaborative relationships or transparency with competitors and customers. Consequently, those relations used as a source of innovation through knowledge spillover, which comes through transparent-based collaboration (sometimes referred to as 'co-innovation') (Lane and Lubatkin, 1998). The argument also supported by Enderwick and Buckley (2019) and Xue et al. (2018), which proves collaboration-based innovation is considered a core component of current innovation theories. Consequently, collaboration-based innovation involves the sharing of various innovation elements within and between enterprises. Moreover, collaboration could be done by involving customers, which can serve as a source of knowledge economy shared by collaborators. The research of Greer and Lei (2012) also argues knowledge sourcing from collaboration enables internal knowledge robust and accelerates the company's innovation process. This kind of innovation with collaboration boosts firms' competitiveness in the international market and fastens the structural change (Brem et al., 2016; Schaufeld, 2015).

Collaboration also considered as a part of the learning mechanism and firms' competition process to be familiarised with innovation and ideation (De Smet et al., 2013). Through this particular learning process, firms need to understand how external pressures and internal dynamics interact day by day (Roper and Arvanitis, 2012; Spanò et al., 2017). The article of Roper and Arvanities reveals that external relations coming through bilateral agreement or policy-related actions influence innovation outcomes. With the umbrella of good innovation strategy firms can create a knowledge-based economy consuming spillovers as a source through collaboration and cooperation based on collateral agreements (Marin, 1989). Marin states that the capability of firms in the pilot application of knowledge spillover has incentivised to grasp new brand innovation success. Therefore, researches recommend that firms that existed in developing countries should find a new way of sourcing spillover knowledge by variables used in open innovation strategy (Yaghmaian, 1994). Adequate researchers agreed many factors could affect innovation strategically. The following section then covers the most arguable variables, which needs policy implications for their actual influence in the success of innovation through transparent sharing of knowledge in collaboration and different form of collateral agreements as discussed above.

2.1 Foreign direct investment

Literature did on foreign direct investment (FDI) recognises its advantage of having a contribution to the innovation process through its knowledge spillover (Beladi et al., 2016; Lin and Kwan, 2016; Xiao and Park, 2018). As those researchers agreed, FDI can contribute to economic growth predominantly through the application of knowledge spillover. For its functionality, FDI requires to have multinational firms, which they tend to exploit their ownership advantages (Xiao and Park, 2018). To gain the fruits of FDI technological and innovative efforts of the host economy shall at least be at the beginning of knowledge-based manufacturing (Lin and Kwan, 2016; Silajdzic and Mehic, 2015). The beginning of knowledge-based manufacturing is expressed by firms' initiation in copying and modifying of sourced knowledge. Thus, spillovers based on FDI create propagative effects for firms' progress of technological advancement (Munteanu, 2015). Due to its propagative effect, developing countries prioritise FDI in their process to catch up with developed countries (Ghebrihiwet and Motchenkova, 2017; Hemmert, 2007).

Especially the study of Cho et al. (2017) reveals foreign direct investment (FDI) is one of the most effective channels through which technology transferred to emerging markets. Contrary to catchup progress, inspired FDI propagation influences to create a leapfrogging capability for learner firms over obsolete technologies (Fu et al., 2018). Consequently, FDI inflow can be a driving force of competitiveness in an economy through the spillover effect of knowledge and technology in the host country (Colen et al., 2016; Nistor, 2015; Okafor et al., 2015). By the study of Todo et al. (2009) a potential channel of knowledge spillovers are turnovers between firms, startups of new firms, technological cooperation between multinational enterprises (MNEs) and domestic firms, and technological outsourcing from MNEs to local firms. Basic education is also the foundation to collect FDI spillovers in domestic firms (Cleeve et al., 2015). Moreover, institutional factors such as political stability, democracy, and rule of law (Bailey, 2018) are an influential factor for FDI effectiveness in structural change. Besides, human capital and R&D seems to be more helpful to capture spillovers from FDI (Cleeve et al., 2015; Tang and Zhang, 2016). In addition to that, Wang and Wu (2016) found that localised innovation activities of foreign-invested firms significantly facilitate innovation of domestic firms.

2.2 Global value chain

The rise of global value chains (GVCs) has revolutionised the way that production processes are carried out in the world economy. Innovation processes have become 'fine-sliced' and dispersed to different firms around the globe (Ambos et al., 2017). Moreover, regardless of the dramatic transformation and spread of modern value chains, the role of value chains in technology adoption has been largely ignored (Swinnen and Kuijpers, 2019). The study Cano-Kollmann et al. (2018) show innovation as the outcome of global networks that connect geographically dispersed knowledge centres. Cano-Kollmann et al. depicted that, multinational enterprises (MNE) generate value by integrating knowledge across national borders. Thus, integrating into GVCs is usually the first step in the catch-up process of emerging economies.

The study of Berghman et al. (2012) shows a new direction on how to be competitive and build a strong innovation strategy by learning (technology acquisition) and knowledge transforming policy using a global value chain as a source of innovation. The study of Pietrobelli and Rabellotti (2011) shows collaborations within the value chain and scientific partners have a positive impact on firms' innovation performance.

2.3 Industry 4.0

Nations have different paths of development over the centuries (Silva and Di Serio, 2016). According to Mahroum and Al-Saleh (2013) in an increasingly globalised economy, the ability to draw in innovations and ideas from elsewhere and build on them to create value at home has become a powerful facility for economic growth. According to Pereshybkina et al. (2017) digitalisation is invading every aspect of our lives and modern technologies. Consequently the digitalised global economy drives for disrupted innovations in every corner of the world (Lom et al., 2016).

The new paradigm is known in the literature as a fourth industrial revolution or industry 4.0 (GTAI et al., 2013). Industry 4.0 involves increasing networking and cooperation between several different partners in international networks of value creation (Müller et al., 2018). Industry 4.0 could be considered either revolution or evolution, disruption, or transformation (Lom et al., 2016). Balasingham (2016) study found that IT-infrastructure and firm size are the critical factors that influence the implementation of industry 4.0 processes. Especially the study of Lim (2019b) reveals that industry 4.0 could bring both opportunities and challenges based on its use and scope of connectivity. The author argues that industry 4.0 could create an opportunity to tackle socioeconomic inequality problems or it may produce threats and worsen socioeconomic disparity. As the study of Balasingham (2016) indicates those mismatches with the revolution occurs due to lack of financial resources, skills mismatches of employees, reluctance to change, and maturity stage are four factors, which negatively correlated with industry 4.0.

Müller et al. (2018) also explored, technological, social and the business paradigm are the key dimensions of change relevant to Industry 4.0. Pereshybkina et al. (2017) reveal to transform with industry 4.0, open innovation, collaborating with large firms, reliance on public institutions for innovation is required. Pertaining to job cuts, de-qualification and new qualification needs on a broad scale are about to occur in the new revolution (Schroeder, 2016). The most important remaining challenge related to the new revolution is sustaining linkages between its different parts as well as its international linkages (Hemmert, 2007).

2.4 National innovation system

As a general truth, for nations in the stage of the catch-up period, their firms expected to follow the strategies and roadmaps of the national innovation system, due to their technological immaturity and dependency on government support. Thus, the national innovation system considered as a supporting tool for enterprises that tries to access knowledge, fund for innovation, government subsidies, and provision to the socio-economic context (Giovannetti and Piga, 2017; Guerrero and Urbano, 2017). For that is the case Davies et al. (2018) study argues, innovation platforms and policies designed to strengthen technology demand increase science and technology (S&T) capabilities of firms. Consequently, technology demand creates a market, which demands a huge amount of technology consumption. However, researchers in this specific area declare that sometimes-national innovation system stands as a barrier in between in linkages order to attain 'national autonomy' (Hemmert, 2007).

2.5 Export oriented industrial policy

By the study of Hojnik et al. (Hojnik et al., 2018) internationalisation increases companies' entrance into foreign markets to participate then it has significantly associated with firm-level economic performance. Besides, internationalisation provides also a motivation for companies to learn and implement innovation (Chen et al., 2017). Meanwhile, Tekin (2012) study shows export-led growth is based on manufacturing and service industries, it supports the economical achievement of least developed countries.

Furthermore, according to Yi et al. (2013), findings suggest that the relationship between innovative capabilities and export performance is not uniform but rather contingent upon the institutional setting in which the firm is embedded. According to the article foreign ownership, business group affiliation, and the degree of marketisation of the region where the firm operates positively moderate the effects of innovative capabilities on export performance. Research results indicate the possibilities for low-income countries to accelerate their economic growth through the application of modern technology in an appropriate policy framework as well as the advantages of relying on manufactured exports (Rana, 1988). Therefore, export orientation raises total factor productivity through its favourable effects on the efficiency of resource allocation, capacity utilisation, economies of scale, and technological change.

3 Research method

The research has a design to use both quantitative and qualitative data to answer the research question. Due to the nature of the study and subjective behaviour of variables, higher experts from selected government organisations and experts from industries has involved during data collection. Specifically, experts from government organisations have selected as far as they are focal to the specific operations of technology transfer. Whereas experts from the selected industries have reached by the e-survey designed to get their opinions through a questionnaire. Thus, the research has classified into two study parts. The first study covers the statistical quantitative investigations using the structural equation modelling (SEM) technique to find out the structural relations of those selected variables in literature. The structural equation modelling used to test the theoretical concept constructed from literature through a model fitness test. In this regard, appropriate variables have selected from discussions on literature followed by scientific procedures. The second study has designed to investigate qualitative data collected through a focal group discussion. Moreover, secondary data from industries and organisations have collected to reinforce the discussions done on focal group discussion (FGD) and questionnaire investigation.

3.1 Study 1

3.1.1 Data collection method

To have reliable answer respondents from each level were limited to experienced staff or senior managers as they are more familiar with the internal situation of their organisations and can answer the questions effectively. Besides, respondents with experience on national policies have considered valid for analysis. To increase the sample size and to include respondents out of Addis Ababa e-survey through http://www.stmesngineering.blogpost.com and phone call interview used as a mechanism to reach respondents' opinions on the issue. However, as per Xue et al. (2018) investigation, there is no consensus on the sample size, needed for structural equation modelling. In this research, a quota sampling technique used by assuming various segments of a population has the same percentage of representation in the sample as they have in the population. However, the elements in the sample have not selected randomly, rather based on judgement. In addition, the planned number of sample sizes is determined randomly to get a proper analysis of structural equation modelling due to its requirement of 100–300 samples size (Gupta et al., 2017).

Interview questions developed for reflection by higher officials of government organisations, expertise in the research area, and individuals spent in the study of innovation systems. Five-point Likert scale questionnaire also designed targeted expertise on the Ministry of Trade and Industry (MoTI), Ministry of Innovation and Technology (MoIT), Ethiopian Investment Commission (EIC), Ethiopian Industrial Park Corporation (EIPC), and local manufacturing firm representatives. Most of the local manufacturing firms selected with the criteria that have connections with multinational enterprises (MNE). The questionnaire is set to measure the influential strategic selected variables innovation process as indicated in Table 4. Factors have measured according to their extensive effect on knowledge spillover concerning practices of innovation and technology transfer. The questionnaire includes five-point scales counting ‘not at all (1)’, ‘little (2)’, ‘moderately (3)’ ‘very much (4)’, ‘extremely (5)’, ‘I don’t know (0)’, and ‘No opinion (0)’. In the research questionnaire ‘not at all’ has taken as a special character. If a respondent answers a selected variable, have no extensive effect for knowledge spillover then it means a respondent knows about a situation, however, the response is a personal opinion of the invisible parameter so that its value cannot be zero. Whereas, ‘I do not know’ and ‘no opinion’ are measurement scales in which the respondent is not familiar and/or does not want to give an opinion on the situation. Due to that, on the data purification step, those values have eliminated before further analysis.

3.1.2 Knowledge spillover model using latent variables

As the above theoretical discussions indicated, selected variables discussed in the introduction part have a direct relation with knowledge spillover (KS), especially for under developing countries. As a case Ethiopian manufacturing industry has influenced by those variables, the government also has taken initiatives to expand MNE involvement through FDI, and export has become a priority objective. Due to that, NIS has launched with a framework of adopting knowledge developed oversea as discussed in the above section. Consequently, the researcher argued, knowledge spillover has a direct relationship with identified variables of industry 4.0, global value chain, foreign direct investment, national innovation system, and export-oriented policies. Each variable has taken as latent variables, which they have measured by structured observable variables measured by a structured questionnaire as indicated in the methodology part.

Thus;

Knowledge spillover model (KS model)

$$ks = \beta 0 + \beta 1\, i4.0 + \beta 2\, gvc + \beta 3\, fdi + \beta 4\, nis + \beta 5\, eoip \tag{1}$$

where *ks* – knowledge spillover, fdi – *foreign direct investment*, *gvc* – global value chain, *nis – national innovation system*, *eoip – export-oriented industrial policy*, and *i*4.0 – industry 4.0. The coefficient $\beta 0$ denoted as the measurement error or residual. While the coefficients of $\beta 1$, $\beta 2$, $\beta 3$, $\beta 4$, and $\beta 5$ are standardised regression coefficients. Since knowledge spillover is the latent variable, the actual measurement has not available.

Thus, regression KS model summary data has calculated by using the average deviation of all influential measurements as a knowledge spillover from the maximum to a minimum. Thus, the knowledge spillover values represent the distance of each influential value to the maximum Likert value, which is 5.

Values of knowledge spillover

$$\begin{aligned} &\textit{Values of knowledge spillover} \\ &\quad = \textit{maximum Likert value} - (\textit{Average}(i4.0, gvc, fdi, nis, eoip)) \end{aligned} \tag{2}$$

The average values of all independent variables represent their average influence on the practice of knowledge spillover. In such calculation when the maximum Likert scale value and the average influence become equal, then the value of knowledge spillover becomes zero. In actual interpretation, zero means consistent data, which means that respondents have the same argument about all independent variables influence the knowledge spillover with equal distance. Thus, calculated knowledge spillover data has transformed into appropriate statistical representation using the SPSS module, which zero value means respondents say the variables have a positive influence on knowledge spillover.

Independent variables reliability test Cronbach's α of 0.850 indicates that respondents have given a consistent view about variables' influence on knowledge spillover. From the items statistics again the measurement of Cronbach's alpha if item deleted shows industry 4.0 = 0.853, global value chain = 0.829, foreign direct investment = 0.812, national innovation system = 0.803, and export-oriented industry policy= 0.804. The result indicates that if the item industry 4.0 deleted from then the internal consistency of respondents' value will have a Cronbach's α value of 0.853. However, the improvement is not significantly different from the previous Cronbach's α value. Thus, the variable has not deleted from the analysis. The regression model summary has indicated the following confirmed facts on the reliability test:

- R-value (=0.878) indicates that the model perfectly predicts the observed data through questionnaire.
- The independent variables account for 76.3% influence on knowledge spillover, the remaining 23.7 percentage of influence cannot be explained by the identified independent variables. The result then provides a room for future research in identifying additional influential variables to the source of knowledge spillover.
- Regression KS model has also statistically significant P value of 0.00, which indicates the model has significantly better for the prediction for knowledge spillover

Table 1 Regression RS model summary

Model	*R*	*R square*	*Adjusted R square*	*Change statistics*			
				R square change	*df1*	*df2*	*Sig. F change*
1	.878[a]	.772	.763	.772	5	130	.000

Notes: [a]Predictors: (Constant), export oriented industry policy, global value chain, industry 4.0, foreign direct investment, national innovation system.
Dependent variable: knowledge spillover.

Based on the regression RS model all independent variables have shown a significant correlation with the dependent variable which can be accepted by the argument that any independent variables can contribute to a prediction of knowledge spillovers. The finding confirms the theoretical clue of the source of knowledge spillover for the innovation process. However, these arguments will not enough unless multi-collinearity test proceeds. SPSS output of Table 2 shows a collinearity diagnostics. As the result shows, the eigenvalue in Table 2 has fair similarity thus the cross product matrix could take as well-illustrated. Therefore, the solutions of the regression parameter are resistive to the changes of any independent variables change or value change of knowledge spillover. Additional measurements for the indication of multi-collinearity are the variance of each regression coefficient that can break down across the eigenvalue and the variance proportion of the coefficient of each independent variable attributed to each eigenvalue.

Table 2 Collinearity diagnostics

Dimension	*Eigenvalue*	*Variance proportions*					
		(Constant)	*I4.0*	*GVC*	*FGI*	*NIS*	*EOIP*
1	5.899	.00	.00	.00	.00	.00	.00
2	.053	.04	.76	.00	.01	.00	.00
3	.020	.26	.04	.11	.06	.06	.18
4	.012	.11	.00	.05	.75	.13	.14
5	.009	.03	.00	.00	.00	.79	.62
6	.008	.56	.20	.83	.18	.01	.06

Note: Industry 4.0 (I4.0), global value chain (GVC), foreign direct investment (FDI), national innovation system (NIS) and export-oriented industry policy (EOIP).

Independent variables have also different variance proportions at different eigenvalues. For instance, industry 4.0 has a 76% variance in the regression coefficient at the eigenvalue of 2, global value chain as 83% variance proportion of the regression coefficient at the eigenvalue of 6, and others also have such different variance proportions at different eigenvalue points. Hence, the result shows all independent variables have a positive association and a direct impact on knowledge spillover. Using B-values from Table 3 and replacing it on β, then the KS model has defined as follows:

KS regression model

$$ks = \beta 0 + \beta 1\, i4.0 + \beta 2\, gvc + \beta 3\, fdi + \beta 4\, nis + \beta 5\, eoip \tag{3}$$

$$ks = 1.564 + 0.24\, i4.0 + 0.115\, gvc + 0.15\, fdi + 0.147\, nis + 0.086\, eoip$$

Table 3 Coefficients of a regression RS model

Model		*Unstandardised coefficients*		*Standardised coefficients*	*t*	*Sig.*
		B	*Std. error*	*Beta*		
1	(Constant)	1.564	.169		9.259	.000
	Industry 4.0	.204	.027	.415	7.481	.000
	Global value chain	.115	.048	.133	2.379	.019
	Foreign direct investment	.150	.044	.210	3.399	.001
	National innovation system	.147	.048	.201	3.086	.002
	Export oriented industry policy	.086	.045	.125	1.905	.059

Thus, the multiple regression model test has proven knowledge spillover has a linear relationship with independent variables while it has dealt with using the remaining artifact involving indicated variables. As the regression model indicates each independent variable could affect the practice of using knowledge spillover. The following selected variables are the top three variables, which have the highest influential coefficient to the knowledge spillover.

- *Industry 4.0* (β = 0.204): the coefficient value indicates that while firms' involvement in industry 4.0 increases by one unit, then its effect on knowledge spillover increases by 0.204 units. On the other view, firms 1,000,000-birr investment in industry 4.0 can lead to capturing 204,000 knowledge spillover capability development opportunities.
- *Foreign direct investment* (β = 0.150): as the firms, involved and funds on foreign direct investment increased by 1 unit then firms' capability on capturing knowledge spillover increases by 0.150 units by holding other factors constant.
- *National innovation system* (β = 0.147): which with a similar argument, 1,000,000 birr investment on national innovation system could lead to the development of 147,000 knowledge spillover capability[2] opportunities.

Firms' knowledge spillovers could be composed of firms' consistent involvement and it may have an influence in the national technology market and added to developing countries' approaches to the innovation process. In this case, the statistical contribution of knowledge spillover by selected variables seems enough and acceptable for the source of innovation. Moreover, firms' direct involvement on the treasures of industry 4.0, foreign direct investment, and strong national innovation system are statistically confirmed variables by experts opinion as a source of knowledge spillover, which functions and a springboard for innovation. The finding indicated in table 4 confirms that firm size (r = 0.573), digitalisation (r = 0.516) are the highest influential variables for knowledge spillover for industry 4.0. Moreover, learner firms leapfrogging capability over obsolete technologies (r = .537) and innovation platforms and policies (r = 0.566) are the significant positive influence for the knowledge spillover capability development practices concerning foreign direct investment and national innovation system respectively.

Table 4 Measures of latent variables and estimated coefficient values their extensive influence for KS

Code	*Latent variables*	*Observable variables*	*Corrected item-total correlation*	*Cronbach' s alpha if item deleted*	*Source*
I4.01	I4.0 variables	Digitalisation	.516	.864	Pereshybkina et al. (2017), Müller et al. (2018) and Balasingham (2016)
I4.02		International networks of value creation	.443	.868	
I4.03		IT-infrastructure	.407	.870	
I4.04		Firm size	.573	.861	
I4.05		Skill, standards and norms, finance	.502	.865	
Gvc1	GVC variables	Integrating into global GVCs	.481	.866	Cano-Kollmann et al. (2018), Pietrobelli and Rabellotti (2011) and Berghman et al. (2012)
Gvc2		Collaborations within the value chain	.464	.866	
Gvc3		Learning (technology acquisition) and knowledge transforming policy	.433	.867	
Fdi1	FDI variables	Ownership influence of multinational firms	.481	.865	Xiao and Park (2018), Fu et al. (2018), Munteanu (2015) and Wang and Wu (2016)
Fdi2		Leapfrogging capability of learner firms over obsolete technologies	.537	.863	
Fdi3		Catchup capability of learner firms over obsolete technologies	.446	.866	
Fdi4		Localised innovation activities	.438	.867	
Nis1	NIS variables	National innovation autonomy	.491	.865	Hemmert (2007), Giovannetti and Piga (2017), Guerrero and Urbano (2017). For that is the case (Davies et al., 2018)
Nis2		Access knowledge	.441	.867	
Nis3		Fund for innovation	.487	.865	
Nis4		Government subsidies	.457	.866	
Nis5		Innovation platforms and policies	.566	.863	
Eoip1	EOiP variables	Internationalisation	.573	.862	Hojnik et al. (2018) and Yi et al. (2013)
Eoip2		The institutional setting	.600	.862	

Note: Industry 4.0 (I4.0), global value chain (GVC), foreign direct investment (FDI), national innovation system (NIS) and export-oriented industry policy (EOIP).

3.1.3 Factors analysis

To measure identified variables, which determine their extent of influence on knowledge spillover (KS) again other variables have identified from the literature as discussed in the introduction, see Section 1. Table 4 shows factors that have an extensive effect on knowledge spillover, has represented through latent variables and observable variables. Latent variables (KS, FDI, GVC, NIS, EOIP, I4.0) are the main variables, which are difficult to measure and to show their direct influence on knowledge spillover. On the previous, discussion the value of the latent variable has discussed using the average value of observable value to show the KS regression model. However, additional observable variables have used directly in a questionnaire survey to measure latent variables concerning their extensive effect on knowledge spillover. Thus, all latent variables are dependent on other situations. In such a scenario, structural equation modelling (SEM) support to show the structural relationship of multiple dependent (latent) variables with observable variables and again the structural relationship of all latent variables to each other. The following table shows the list of variables and statistically significant estimated coefficient values to the latent variables. As the table shows the latent variables have a positive influence on the observable. Thus, when latent variables go up by 1 standard deviation, then the observable variables go up by estimated standard deviations indicated on the table. Thus, firms' decisions on investing in the latent variables then have a direct positive influence on the observable variables. Measuring observed values have also Cronbach's α value of 0.871 with the Cronbach's α value if the item deleted; all values show less than their Cronbach's α value as indicated in Table 4. The result showed the removal of any observable variable would result in a lower Cronbach's α value. Therefore, selected observable variables will go the structural modelling discussed in the next subtopic.

The confirmatory factor analysis is the most suitable technique to summarise and decrease the number of variables to a few factors to fulfil the objectives of the research. However, as discussed above if any of the variables deleted from the list the Cronbach's alpha value will decrease with the number listed on Table 5. Due to that measure of sample adequacy (MSA) done using KMO (Kaiser-Meyer-Olkin) measure which results (=0.871) indicates identified dependent factors and the sample size have sufficient observation for each factor.

However, the inclusion of variables and sampling adequacy on analysis cannot guaranty the accuracy of predicting through the given value of respondents. Thus, principal component analysis (PCA) communality measurement displays total influence on a single observed variable from all the factors associated with it. The measurement has interpreted as the same used in multiple regression above Section 3.1.2, which is similar to the sum of all the squared factor loadings for all the factors related to the observed variable and this value is the same as R^2 in multiple regression. The value ranges from zero to 1 where 1 indicates that the variable can be fully defined by the factors and has no uniqueness. In contrast, a value of 0 indicates that the variable cannot be predicted at all from any of the factors. In CPA analysis, at least the communality value greater than 0.5 considered as acceptable. Therefore, from surveyed 19 variables with the commonalities extraction process factor loading of ownership influence of multinational firms (=0.392), Internationalisation (foreign markets to participate) (=0.427), learning (technology acquisition) and knowledge (=0.464), access knowledge (=0.465), integrating into global GVCs (=0.478), collaborations within the value chain (=0.340), digitalisation (=0.385), firm size (=0.497), and skill, standards and norms, finance (=0.497) had deleted. Consequently, factors have reduced into ten variables in which at least 50% of variables influence knowledge spillover could be explained by the relationship of the factors.

Table 5 Rotated component matrix after deletion

Rotated component matrix	*Code*	*Component 1*	*Component 2*	*Component 3*	*Extraction after deletion*	*Cronbach's alpha if item deleted*
International networks of value creation	I4.02	.178	.088	.807	.691	.776
IT-infrastructure	I4.03	–.007	.167	.811	.685	.788
Leapfrogging capability of learner firms over obsolete technologies	Fdi2	.748	.258	.035	.627	.754
Catchup capability of learner firms over obsolete technologies	Fdi3	.774	.136	–.019	.618	.764
Fund for innovation	Nis3	.813	.091	.199	.709	.754
Localised innovation activities	Fdi4	.060	.730	.063	.540	.763
National innovation autonomy	Nis1	.094	.705	.225	.557	.755
Government subsidies	Nis4	.228	.677	-.034	.511	.761
Innovation platforms and policies	Nis5	.307	.624	.199	.523	.750
The institutional setting in which the firm is embedded	Eoip2	.561	.523	.150	.611	.746

Note: Industry 4.0 (I4.0), global value chain (GVC), foreign direct investment (FDI), national innovation system (NIS) and export-oriented industry policy (EOIP).

After factor reduction, Table 6 showed identified three factors for further analysis. The first factor consists of variables with component loading of the leapfrogging capability of learner firms over obsolete technologies (=0.748), catch-up capability of learner firms over obsolete technologies (=0.774), a fund for innovation (=0.813), and the institutional setting in which the firm is embedded (=0.561). The second factor consists of localised innovation activities (=0.730), national innovation autonomy (=0.705), government subsidies (0.677), and innovation platforms and policies (0.624). Whereas the third factor consists of variables correlation (or component loading) to the group factor including variables of networks of value creation (=0.807) and IT-infrastructure (=0.811).

Based on factors extracted above, the new rotated component factors have given a new name as follows:

- fund and institutional setting for leapfrog and catchup capability (factor 1)
- local Innovation system (factor 2)
- IT and network for value creation (factor 3).

Reduced factors have also Cronbach's alpha based on standardised items (= 0.804) in which indicated the value of Cronbach's alpha if item deleted is below items total reliability value. Thus, the result also confirms variables internal consistency has not affected by the factor reduction process, which allows the next analysis.

3.1.4 Structural equation modelling

The full structural model has tested to verify the regression KS model and the relationship among latent variables along with observable variables. The structural equation model (SEM) uses the approximate values to simplify the actual situation to measure knowledge spillover through multiple latent variables. Based on the confirmatory factor analysis discussed above, the observable factors structural equation model has developed based on the confirmed regression KS model for its good fitness. In the assessment of the fitness test of selected models, both regressions only with latent variables and with latent and observable variables have done with SPSS_AMOS software.

Table 6 Assessment of good fit test SPSS_AMOS output

Models		*X2(df)(P_Value)*	*RMSEA*	*NFI*	*CFI*	*GFI*	*X2/df*
Model 1	Limited KS model only with latent variables	18.270(5)(0.03)	.140	.943	.957	.951	3.654
Model 2	KS model with both latent and observable variables	181.881(142)(.013)	.046	.774	.937	0.877	1.281
Model 3	KS Model after principal component analysis (PCA)	45.423(32)(0.058)	.056	.873	.957	.939	1.419

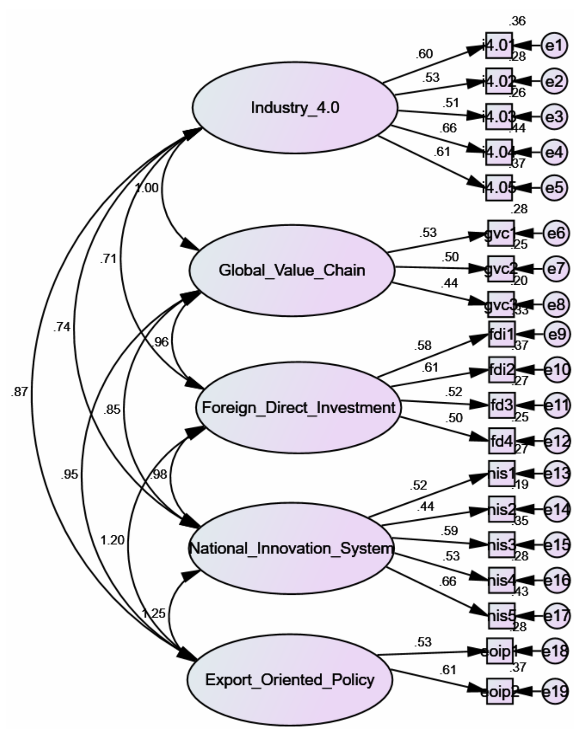
The assessment for goodness fit test has measured with selected indicators adopted from (Hsu et al., 2012; Schumacker and Lomax, 2016). As authors indicated the selected models has shown fit good as follows:

- Chi_square test: X2 test, compares obtained χ^2 value with tabled value for given df, all models have shown fit
- Degree of freedom; models fit with df value of greater than 1.
- Relative chi-square test: X2/df: models show better for a model fitness when with a ratio calculated as 3 to 1 thus all models are acceptable fit.
- P_Value: models are significant at the .05 level. All models fit.
- The root-mean-square error of approximation, only model three fitted with RMSEA value of .05 to .08.
- Normed fit index (NFI) 0 (no fit) to 1 (perfect fit), all models fit.
- Goodness-of-fit index (GFI) Values are close to .90 or .95 which reflects a good fit
- Comparative fit index (CFI) with values > .90 models considered acceptable. Models 1 and 2 are acceptable.

3.1.5 KS model with both latent and observable variables

As indicated in Table 4, the covariance estimation matrix of the global value chain with a national innovation system and foreign direct investment has shown a significant lowest covariance value of 0.232 and 0.217 respectively. As the estimation, indicates the respondents hardly argue with the global value chain relational effect on contribution for knowledge spillover. This point also argued with a focus group discussion that, national innovation system should do more on research and development activities rather than searching for knowledge spillover on the global value chain interactions even if literature argue about its effect. However, the global value chain and national innovation system have a shown slightly higher relationship with industry 4.0 with an estimated value of 0.405 and 0.402 respectively. The result then showed that respondents have a similar consensus that industry 4.0 has an exterior variable concerning its influence on the knowledge spillover. Consequently, the estimation of the global value chain as a source of knowledge spillover has given the highest value with industry 4.0.

Figure 1 Path diagram of KS model with both latent and observable variables (see online version for colours)



The national innovation system has also slightly high covariance value with industry 4.0 and with other variables except for the global value chain, which indicates respondents' argument, on the national innovation system, shall have strict, and follow up its policy of adopting of spillover knowledge. However, as it is shown the relationship estimation value is not that much high as it is expected which shows the respondents also have censuses rather than focusing on the adoption of exterior knowledge national innovation system has to also focus on internal R&D.

Table 7 Drivers of innovation value chain association test

Covariance matric			*Estimate*	*S.E.*	*C.R.*	*C.R²*	*P*
EOIP	↔	I4.1	.394	.099	3.980	15.84	***
I4.0	↔	GVC	.405	.098	4.118	16.96	***
I4.0	↔	FDI	.385	.101	3.801	14.45	***
I4.0	↔	NIS	.402	.107	3.777	14.27	***
EOIP	↔	GVC	.217	.055	3.957	15.66	***
EOIP	↔	FDI	.366	.080	4.603	21.19	***
EOIP	↔	NIS	.384	.085	4.512	20.36	***
GVC	↔	FDI	.261	.063	4.183	17.5	***
GVC	↔	NIS	.232	.060	3.852	14.84	***
FDI	↔	NIS	.360	.085	4.258	18.13	***

Note: Industry 4.0 (I4.0), global value chain (GVC), foreign direct investment (FDI), national innovation system (NIS) and export-oriented industry policy (EOIP), and *** represent statistical significances at $P \leq 0.001$.

As indicated in Table 7, all critical ratio estimates shown greater than two (in absolute value) (Tang and Zhang, 2016), Thus, all paired relation estimate has significant relations in all directions. In addition, the square of critical ratio ($C.R^2$) test is done to demonstrate the amount by which the chi-square statistic would increase if the analysis were repeated with identified paired parameters fixed at zero. Consequently, results display small inconsistencies by fixing the identified paired parameter at zero. In this case, the result argues even if those factors have a positive association with each other there relation does not affect with a presence or absence of other paired variables. So that paired variables are true relations, in which their relationship could be stated, as they are standalone, variables for a model. For example, the global value chain and industry 4.0 have a positive association with a magnitude covariance value of .405. This means a change in 40.5% in the global value chain for knowledge spillover is associated with the same change in industry 4.0. However, if this change is neglected and assumed industry 4.0 and global value chain does not contribute to knowledge spillover, $C.R^2$ result shows; other paired relations continue to contribute to knowledge spillover without affecting chi-square statistics value of a general model. This is due to, industry 4.0 and the global value chain has paired relations with other variables. In addition, factors cross-relational effects that are in pairs have an individual influence on knowledge spillover, whether a single paired relation has created, or not, factors indirect influence in knowledge spillover exists. This leads to a conclusion that nations' policy design should think through, whether it neglects the influence of industry 4.0, the revolution effect could not be stopped since it has indirect contacts with other parameters unless nations have a closed-door policy for entire variables. Which will not come possible ever!

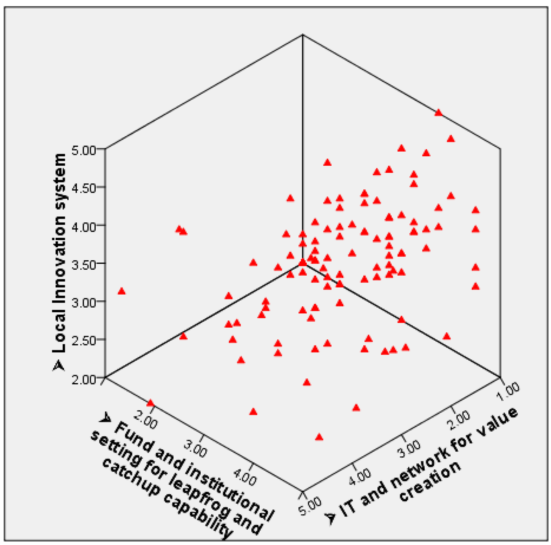
3.1.6 KS model after principal component analysis

After principal component analysis factors has reduced into three groups incorporating selected ten variables. Thus, the factor analysis condenses important influential information held in a large number of variables into a few numbers of sets of factors or components. Consequently, KS model after PCA reveals very practical results about predicting knowledge spillover from a few variables, refer to Table 8.

$$ks = \eta 1 f1 + \eta 2 f2 + \eta 3 f3$$
$$ks = 0.775 f1 + 0.966 f2 + 0.532 f3$$

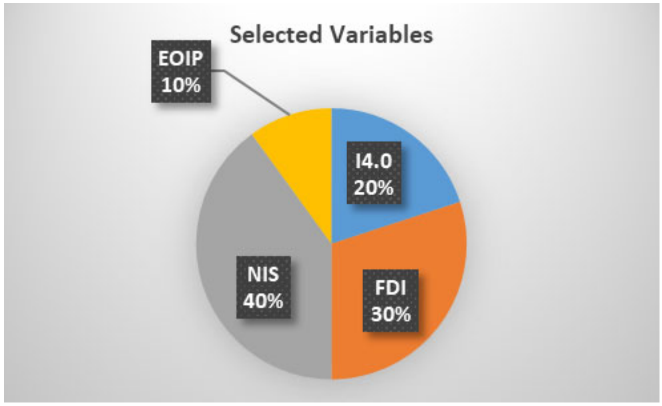
where η is the standardised regression coefficient, f represents reduced factors by the process of PCA process. The results indicated that fund and institutional setting for a leapfrog and catch-up capability ($f1$), local innovation system ($f2$), and IT and network for value creation ($f3$) has shown a statistically significant set of predictions of the level of knowledge spillover.

Figure 2 3D scatter plot of selected factors (see online version for colours)



Moreover, Figure 2, shows a linear relationship of selected variables. The positive standardised regression coefficient indicates that knowledge spillover of firms statistically could increase with firms' determined involvement on $f1$, $f2$ and $f3$. In such a simple regression equation, when factors 1, 2 and 3 go up by 0.775, 0.966 and 0.532 standard deviations respectively then the predicted knowledge spillover goes up by 1 standard deviation. The result also confirms with one unit of change in the knowledge spillover there are more opportunities for change firms that have an institutional setting to finance innovation practices, strives to develop catch-up and leapfrogging capabilities rely on local innovation systems, and built IT and network for value creation. From the reduced variables indicated in Table 5, 40% of the variables are selected from the national innovation system. In reverse to those global value chain variables have not selected in PCA analysis, which shows a small communality number that exhibits global value chain variables are analytically independent and cannot club with the rest of the variables. The result then reveals the fact and repeats the finding as respondents hardly argue with the global value chain relational effect on contribution for knowledge spillover.

Figure 3 Selected sources of knowledge management process (KMP) (see online version for colours)



Whereas, respondents argue national innovation system with identified variables of fund for innovation, national innovation autonomy, government subsidies, and innovation platforms and policies could support for capability development of using any spilled over knowledge, which could use for technology development purposes. Therefore, the particular finding supports the requirement of strong R&D institutes, which do researches and develop concepts into reality so that spilled knowledge can be as additional assets to support the national innovation system. One-way or another, the finding answers were the source of KMP, which is knowledge spilled over from those identified sources, however; investigating their effect knowledge spillover on innovation is the ultimate interest of this research.

Table 8 Regression weights: selected sources of KMP

			Estimate	*S.E.*	*C.R.*	*P*
Factor1	←	Knowledge_Spillover	.775			
Factor2	←	Knowledge_Spillover	.966	.328	2.957	.003
Factor3	←	Knowledge_Spillover	.532	.300	3.258	.001
fdi2	←	Factor1	.699			
fd3	←	Factor1	.609	.146	6.107	***
nis3	←	Factor1	.688	.142	6.803	***
eoip2	←	Factor1	.739	.136	6.634	***
fd4	←	Factor2	.518			
nis1	←	Factor2	.619	.278	4.716	***
nis4	←	Factor2	.575	.253	4.569	***
nis5	←	Factor2	.689	.269	4.605	***
i4.02	←	Factor3	.665			
i4.03	←	Factor3	.585	.323	2.847	.004

Note: Industry 4.0 (I4.0), global value chain (GVC), foreign direct investment (FDI), national innovation system (NIS) and export-oriented industry policy (EOIP), and *** represent statistical significances at $P \leq 0.001$

The standard coefficient of selected sources of KMP showed that factor 2 which is practicing localising the national innovation system has a huge influence on using knowledge spillover (0.966). Structurally localising national innovation system has the highest influence on towards using knowledge spillover through a national innovation system, when it has an autonomy of practicing and making decisions on the innovation outputs. As indicated in table 8 when the practice of localising innovation system (factor 2) goes up by one standard deviation, then the autonomy of practicing innovation goes up by 0.619 standard deviations. The second most influential variable to the practice of using knowledge spillover is an institutional setting that its catchup and leapfrogging capability development has backup by funds. Consequently, the institutional setting in which the firm is embedded and Leapfrogging capability of learner firms over obsolete technologies, and Fund for innovation contribute to the practicing of using knowledge spillover. In all those progress, information technology (IT) infrastructure development, firms strong international network development for value creation, and use of knowledge spillover through the external interactions.

3.2 Study 2

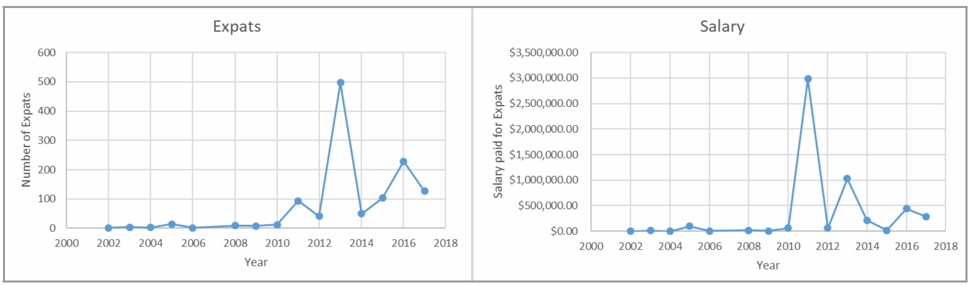
3.2.1 Data collection method

The focal group discussion (FGD) was arranged with the Ethiopian Investment Commission (EIC), Ethiopian Industrial Park Corporation (EIPC), Ministry of Innovation and Technology (MoIT) and with Ministry of Trade and Industry (MoTI) to investigate the efforts of local manufacturing firms in acquiring knowledge through strategic road maps and policies from abroad into the country was a primary agenda. Then the enactment of the MoTI in supporting training institutes and conveying policies with regard to increasing the potential of domestic firms has discussed. In addition, Ethiopian investment commission commitment in assuring multi-international enterprises objective in bringing maximum value addition and ways of knowledge transfer discussed with the commissioner and representative officers. The processes of knowledge acquiring, transferring, and diffusing activities by domestic firms are discussed with the Ethiopian ministry of innovation and technology (MoIT). Furthermore, the FGD was upheld with Industry Park Corporation (IPC) representatives using discussion issues related to activities related to joint venture progresses and success factors in knowledge transfer activities of MNE in the industry park and local firms outside the park.

3.2.1 Knowledge acquiring practice of manufacturing firms in Ethiopia

According to the FGD result with IPC representatives, foreign investors allocated in industrial parks are encouraged to outsource some of their processes to local firms for the purpose of technology transfer. However, the outsourcing jobs for the local domestic firms are not up to the standard, and allocated tasks for outsourcing are just to fulfil incentive requirements by the MNE. To resolve such kind of gaps, the Ethiopian Investment Commission (EIC), encouraged foreign firms to create joint ventures in industrial parks with domestic firms to facilitate the technology transfer process altogether. However, still, now (at least during the publication of this chapter) there is no joint venture created in industrial parks. As compensation for such a problem, the ministry of trade and industry requests domestic firms to hire ex-pats so that they can facilitate the technology transfer process in the domestic firms using the experience of ex-pats in the manufacturing process. To do that EIC follow-ups the ex-pacts success in the domestic firms by following their success in the exercise of replacing ex-pats with local expertise. According to the FGD discussion, the number of ex-pats expected to decrease if the plan of replacing ex-pats with local ex-pats is successful. As illustrated in the FGD discussion, the number of foreign employees for technology transfer increased gradually starting from 2010 G.C. According to the discussion result, the gradual improvement of foreign employees in domestic firms showed the government's strong interest in assembling knowledge, human resource management, and other experience-based assets into domestic firms.

Figure 4 Hiring experience of expats for the purpose of technology transfer (see online version for colours)

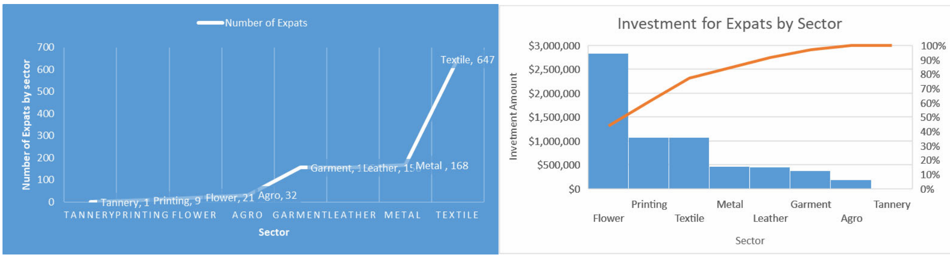


Source: Secondary data: authors own calculation sourced from Ethiopian Ministry of Trade and Industry

The peak point (2012–2014) for ex-pats graph demonstrates that the time of more foreign investors started their operation in industrial parks located in Addis Ababa and all over regional states. The inclined curve after 2016 shows local experts are replaced ex-pats according to the government plan as discussed above. The EIC representatives justify the occurrence as it has happened due to domestic firms' desire on involving local expertise through the attachment and strong reporting mechanisms every three years. Thus, on the figure, the zigzag line represents an increase and decrease of ex-pats as they replaced and again hired along the period. According to FGD, in 2011, $2,809,672.00 has been paid for ex-pats and other expenses. The expense reaches to higher pic level due to onetime payment, which was not done before.

As indicated in Figure 5, the highest number of ex-pats (≈647) for local firms have assigned in textile industries, for the purpose of technology transfer. FGD result reveals the amount of investment to foreign experts has directly related to the level of expertise. For instance, the payment of ex-pats is high with their expertise level. Thus, a large amount of ex-pats does not mean they have that amount of knowledge to transfer to the local firms. In this regard, ex-pats assigned to the flower industry is has paid more than ex-pats assign in the garment industry. As per this result, ex-pats assigned to flower industries have the highest relative knowledge than ex-pats hired to the other sectors. On the other way according to FGD, except the flower industry sector, foreign employees imported to other sectors are mostly involved in less technical processes. Based on this finding, investment in knowledge and technology transfer by learning from oversea technologies and expertise originates from abroad has only registered high in the flower sector, while other sectors have a chance to access fewer technical experts. Thus, learning from overseas technologies and practicing knowledge spillover remained far beyond a horizon to the local firms that existed in Ethiopia.

Figure 5 Analysis of foreign employee by sector (see online version for colours)



Source: Secondary data: authors own calculation sourced from Ethiopian Ministry of Trade and Industry

Moreover, if knowledge acquired and transferred into the institutional setting through strategic policies, it is a natural circumstance that the number of foreign employees for technology transfer reduced to the required level, and MNE has structured by domestic and foreign firms' joint ventures based on strong bilateral relationships. However, results show still ex-pats are trade-in and joint ventures still not created for technology transfer. Consequently as shown in Figure 5, the number of foreign employees keeps hired in their existence in every sector. In conclusion, the following major challenges have identified using FGD and personal interviews with focal persons of MoIT, MoTI, EIC, and EIPC related to foreign experts and institutions involved in technology transfer.

- due to ex-pats need to stay for a long time with attractive payment sometimes they are not volunteering to transfer their knowledge into domestic experts
- frequently foreign experts have low capacity on the area even they were hired as expertise
- institutes who are responsible to control technology transfer do not have a clear structural working process
- beyond assigning institutions on the process, government organisations have limitations on follow up
- limited capacity and knowledge from institutes to control foreign experts on the process of their responsibility in delivering technology transfer activities.

In general, from the FGD, the focal person dialogs indicate that joint venture, subcontracting, strong institutional setup, and cluster-based industrial development are factors, which should be, targeted to strengthen technology transfer activities from MNE into domestic manufacturing firms. Furthermore, from the FGD, participants in all section argued that in technology transfer, absence of monitoring and evaluation techniques in quantifying the amount of knowledge transfer from ex-pats to the local expert still rolls and make the ambition of government plan in installing FDI hooked on the trash. However, with all trials in attracting investment EIC, IPC, and other government organisations in the circle struggle in supporting and facilitating local and domestic investors in different instances. For example, investors expedited to work with an increase in using local raw material, encompass outsourcing activity, increase the amount of knowledge-based activities locally so that local experts can have a chance to learn the activities and own technological processes for their advantage. Such ambitions according to FGI participants, have a chance of maximising knowledge transfer even if a proper way of measurement is not available still. Holding those practical implications with local firms and MNE the following section investigated factors influence called strategic driving variables of innovation (ISVI) towards knowledge spillover, which considered in the literature review as a source of innovation. Thus, the section also measured indirectly variables influence on local firm's success in achieving the process of capturing knowledge.

4 Discussion

According to Munteanu (2015) knowledge spillover propagation effects, especially in terms of technical knowledge and know-how, enable the creation of robust innovativeness growth. Statistical test findings indicate especially fund and institutional setting for leapfrog and catchup capability, localising Innovation system, and IT and network for value creation affect the national economy by driving innovation towards knowledge spillovers. Meanwhile, as the above statistical findings confirmed whether developing nations are ready or not, the influence of selected variables on the technological development process cannot be neglected. Thus, with the limited financial performance of firms in developing countries innovation performance also cannot easily be realised without confirmed strategic policies and actions concerning those variables discussed in Section 1. Statistical results also indicate that a national innovation system should do more on research and development activities rather than searching spillover on the global value chain. Therefore, science and technology policies should support and enhance the strengthening of R&D activities rather than only assembling knowledge spillovers. Particular findings such as Yip and McKern (2014), Zerwas (2014) and Zhang and Gallagher (2016) study support nations should have strong R&D institutes, which do researches and develop concepts into reality so that spilled knowledge's can be as additional assets to support national innovation system. However, there is still a paradox that with less R&D intensive nations like china have been exporting successfully (Yi et al., 2013).

The statistical finding also confirms 70% of influential variables are selected from the national innovation system and (40%) and foreign direct investment (30%). The selection approves the respondents' argument on a strong national innovation system is a prior option about practicing of knowledge spillover. Whereas developing countries determined involvement in foreign direct investment has also a strong influence on using knowledge spillover. In general, based on the above statistical findings, arguments made on the issue that, more spillovers notified when there are strong institutional settings and IT infrastructures. Thus, well-known knowledge could then collected directly by strong organisational learning abilities through their desire of catchup and leapfrogging to technologies available elsewhere. Consequently, such kind of countries' determination to learn and practice from other developing countries recognised as a very critical mechanism for development for least developed countries (Clark and Tracey, 2004; Huang et al., 2012; Wixted, 2009). Hence, responsible bodies such as private research institutes, governmental research institutes, and non-governmental research institutes have to do check and balance on their research and development activities to optimise the effects of external influences thorough knowledge spillover. Those abilities could be formed through continuous formal education, short and long training, and symposiums.

5 Conclusions

As the empirical investigation and FGD result show knowledge spillover requires developing countries' policy direction and local firms' determination to acquire it with identified variables of industry 4.0, global value chain, foreign direct investment, exporting process, and even in the national innovation system. As Sonobe and Otsuka (2006) described, a global value network deals only with enterprises that produce a reasonably high quality of products. Thus, firms in the lower technical levels cannot rely on the global value chain and in the international market. Then transferred technology tested repeatedly in the international market until it becomes a distinctive trademark. Until developing countries develop such capability, the respondents argue with the dispute of institutional setting to tide up local firms with FDI and develop capabilities with new technology trends practiced in multinational enterprises. Parallel to such disputes empirical investigations also confirms that the national innovation system should act in the leadership of in the process of innovation practices, which has counted by knowledge spillovers and R&D performances.

In general, for the practice of using knowledge spillover coming through external sources, the above statistical results confirm that developing countries should start to practice localising knowledge spillover in their national innovation system, the national innovation system shall be backed up by institutional settings which are ready to develop leapfrog and catchup capability with sufficient funding system, and information technology infrastructure development has to get full emphasis to network for local firms in the value creation process.

Moreover, joint venture, subcontracting, strong institutional setup, and cluster-based industrial development are factors, which should be, targeted to strengthen technology transfer activities from MNE into domestic manufacturing firms. Besides, monitoring of firms' activities on technology transfer (especially related to ex-pats) maintains innovation performance with strong national innovation system and policies.

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Notes

1 Pure R&D – "…..is the process by which a company works to obtain new knowledge that it might use to create new technology, products, services, or systems that it will either use or sell (https://www.shopify.in/encyclopedia/research-and-development-r-d).

2 The unit of knowledge spillover capability has assumed the number of technological opportunities, which used as the source for the innovation value chain.