CONSTRUCTION SUPPLY CHAIN, INTER-SECTORAL LINKAGES AND CONTRIBUTION TO ECONOMIC GROWTH: THE CASE OF EGYPT

Mona Esam[1] and Maye Ehab[2]

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[1] Associate Professor, Faculty of Economics and Political Science, Cairo University.

[2] Economist, the Egyptian Center for Economic Studies (ECES).

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Abstract

The construction sector is considered a key sector in the Egyptian economy and a main contributor to economic development, specifically in total employment. This paper examines the construction sector intersectoral linkages and contribution to economic growth. The purpose is to identify the effect of a boom in the construction sector (due to government stimulus packages or heightened construction activity for instance) on other sectors as well as on economic growth in Egypt. Hence, the paper first identifies and analyzes the supply chain of the construction sector in Egypt, with a highlight on the size of SMEs and subcontracting in the sector. It then studies the intersectoral linkages of the construction sector and their implications on the Egyptian economy. This is conducted through an analysis of Egypt's input-output (I/O) tables for the years 2007/2008, 2008/2009 and 2010/2011; in addition to time series analysis of quarterly data for the period from 2001/2002 Q1 till 2014/2015 Q2. The I/O table analysis demonstrates strong backward linkages of the construction sector, which indicate that the sector depends on other sectors in its inputs. The forward linkages indicator, on the other hand, is not as high as the backward one showing that the supply of the construction sector is mainly targeting new construction rather than repair and maintenance. The time series analysis report consistent results with the I/O table analysis, in the long run. The pull effect of the construction sector proved to be significant for both the financial and insurance activities sector, as well as the wholesale and retail trade activities one.. This long-run relationship is quite stable and mean reverting, as indicated by the vector error correction model (VECM). In the short-run, however, results indicate that wholesale and retail trading sector have the largest contribution in explaining movements in the construction activities, followed by the financial intermediation and insurance activities, then the mining and quarrying sector, and lastly the manufacturing one. Finally, the Granger causality and cointegration analysis show high multiplier effects, of the construction sector, stemming from its extensive backward linkages, which have positive impacts on the macroeconomic performance. Accordingly, the construction sector is expected to be a backbone of the domestic economy that not only promotes economic performance, but also has strong pull effects to a number of feeding industries.

Keywords: construction, Egyptian economy, inter-sectoral linkages, economic growth, input-out tables, SMEs, vector error correction model, Granger causality, co-integration analysis, push-pull effects

JEL Classification: R15C32

ملخص

يعتبر قطاع التشييد والبناء قطاعا رئيسيا في الاقتصاد المصري ومساهما رئيسيا في التنمية الاقتصادية، وتحديدا في إجمالي التشغيل. وفي هذا الإطار، تناقش هذه الورقة الروابط بين القطاعات وقطاع التشييد والبناء ومساهمته في النمو الاقتصادي. والهدف من ذلك هو تحديد التأثير الناجم عن طفرة في قطاع التشييد والبناء (بفعل الحزم التحفيزية التي أطلقتها الحكومة أو بفعل تزايد نشاط التشييد والبناء على سبيل المثال) على القطاعات الأخرى، وكذلك على النمو الاقتصادي في مصر. ومن ثم تحدد الورقة أولا سلسلة التوريد في قطاع التشييد والبناء في مصر، وتقوم بتحليلها مع إلقاء الضوء على حجم المشروعات الصغيرة والمتوسطة والتعاقد من الباطن في القطاع. ثم تنتقل إلى دراسة الروابط بين القطاعات وقطاع التشييد والبناء وآثارها على الاقتصاد المصري، وذلك من خلال تحليل جداول المدخلات والمخرجات لمصر في السنوات ٢٠٠٨/٢٠٠٧، ٢٠٠٩/٢٠٠٨ و٢٠١١/٢٠١٠ بالإضافة إلى تحليل السلاسل الزمنية للبيانات ربع السنوية للفترة من الربع الأول للعام ٢٠٠٢/٢٠٠١ حتى الربع الثاني للعام ٢٠١٥/٢٠١٤. ويُظهِر تحليل جداول المدخلات والمخرجات قوة الروابط الخلفية لقطاع التشييد والبناء، مما يشير إلى اعتماد القطاع على قطاعات أخرى للحصول على مدخلاته. أما مؤشر الروابط الأمامية فليس مرتفعا بذات القدر، مما يشير إلى أن العرض في قطاع التشييد والبناء يستهدف البناء الجديد في الأساس وليس الإصلاح والصيانة. وتتسق نتائج تحليل السلاسل الزمنية مع تحليل جداول المدخلات والمخرجات على المدى الطويل. وأثبت تأثير الجذب (pull effect) لقطاع البناء أهميته بالنسبة لقطاع الأنشطة المالية والتأمين، وأنشطة تجارة الجملة والتجزئة. وهذه العلاقة طويلة الأجل تتسم بالاستقرار والعودة للمتوسط، كما يتضح من نموذج متجه تصحيح الخطأ. غير أنه في المدى القصير، تشير النتائج إلى أن قطاع تجارة الجملة والتجزئة هو صاحب أكبر مساهمة في تفسير التغيرات في أنشطة التشييد والبناء، تليه أنشطة الوساطة المالية والتأمين، ثم قطاع التعدين والمحاجر، وأخيرا قطاع الصناعة التحويلية. وفي النهاية، يبين تحليل جرانجر للسببية وتحليل التكامل المشترك ارتفاع التأثيرات المضاعفة لقطاع التشييد والبناء، نتيجة امتداد روابطه الخلفية، والتي لها آثار إيجابية على الأداء الاقتصادي الكلي. وبالتالي، من المتوقع أن يمثل قطاع التشييد والبناء العمود الفقري للاقتصاد المحلي حيث إنه لا يقوم فقط بتعزيز الأداء الاقتصادي، ولكن له أيضا آثار جذب قوية على عدد من الصناعات المغذية.

I. INTRODUCTION

The construction sector plays a significant role in Egypt's economic development, accounting for 11 percent of total employment and contributing 5 percent to GDP on average over the period 2009/2010–2013/2014.[1] It caters to an increasing demand of residential and non-residential consumers in addition to providing the necessary infrastructure. The government has structured a number of stimulus packages that mainly target the construction sector. This is in addition to the huge investments in the Suez Canal, as well as the one million housing units, among other construction and infrastructure projects. These projects and increased spending are expected to increase the output of the construction sector. Given the heightened construction activity initiated by the Egyptian government,[2] it is of crucial importance to understand the effect of the increase in construction output on the Egyptian economy. Moreover, it is quite relevant to estimate its multiplier effect on the economy through calculating the forward and backward linkages with other sectors to understand how the output of these sectors will be affected accordingly.

The private sector is dominating the construction activities, where its share in total investments represents 73 percent in 2013/2014. In addition, 92 percent of the construction firms are small and medium enterprises yet accounting for 19 percent of total value added in the sector. Moreover, the sector suffers from a high degree of informality, which results in underestimation of the official construction figures and statistics.

There is considerable research on the relationships between the construction sector and other sectors in several economies. Some papers focus on determining the forward and backward linkages of the construction sector using input-output (I/O) tables' analysis. Rameezdeen and Ramachandra (2008) identified the construction linkages in a developing economy, namely Sri Lanka using I/O tables. They found that the push effect (forward linkages) of the construction sector is insignificant, while the pull effect (backward linkages)

[1] For the purpose of this research, the construction sector is defined as: i) construction of buildings, including residential and non-residential buildings, ii) civil engineering (including roads and railways, utility projects, and other civil engineering projects), and iii) specialized construction activities. The specialized construction activities include demolition and site preparation, electrical, plumbing and installation activities, and building completion and finishing (the International Standard Industrial Classification (ISIC), revision 4).

[2] This is indicated in the National Social Housing Plan 2012/2013 and the Government of Egypt (GoE) plan of 2015/2016 (Ministry of Planning and Follow-up and Administrative Reform 2015; for further details see Section II).

is significant. An aggregated sectoral analysis reveals high dependence of construction on manufacturing followed by services. In addition, the direct and total inputs from manufacturing and services increase over time. Polenske and Sivitanides (1990) discussed the nature of forward and backward linkages of construction and their role in inducing economic development for a number of developed and developing countries. They found that gross construction linkages are strong and that the economic impact of construction activity is relatively evenly dispersed over the sectors from which they obtain their inputs. Kofoworola and Gheewala (2008) used three I/O tables to examine the significance of the construction sector and its relationship with other sectors of the Thai economy. The pull effect was larger than the push one. This shows that the construction sector has the potential to trigger production in sectors linked to it. The paper also concluded that the sector depends highly on manufacturing sector followed by services. This indicates the high backward linkages of the construction sector in several countries. It is thus important to validate the existence of such linkages in Egypt and which sectors are highly linked to the Egyptian construction sector, hence the need to focus the policies on these sectors.

Other papers focus on the impact of fluctuation in construction sector output on the sectoral production and the whole economy. Lean (2001) determined the impact of fluctuation in construction output on the sectoral production and the economy of Singapore using vector auto-regression (VAR) and Granger causality. The results of the paper helped in understanding the impact of the construction sector on the other sectors of the economy. Bidirectional linkages were found between the construction sector and other sectors in the economy and GDP. It showed that change in the construction sector output has a multiplier effect on the economy over the short to medium terms. Another paper studied the linkage between the construction sector and the manufacturing sector in particular (Khan, Liew, and Ghazali 2012).This paper also employed the Granger causality test and the VAR to determine the causal relationship between the two sectors and measure the effect of changes in output in one sector on the other. The results showed that there was a strong correlation and bidirectional causal relationship between the construction and manufacturing sectors. Osei (2013) employed a Granger causality test and Johansen co-integration methodologies to identify the relationship between the construction sector and economic growth in Ghana. The study found that the construction sector activity promoted economic growth in Ghana and the relationship remained positive over time. Hence, it is of crucial importance to identify the

effect of a change in the construction sector output, in the case of Egypt, on other sectors, like manufacturing and services, as well as on economic growth.

Regarding the literature about Egypt's construction sector, Abdelhamid et al. (2014) identified the current risk management approach for Egyptian contractors. It concluded that the main elements to avoid cost overruns and delays of payment include supplier selection criteria, suppliers' qualifications, logistics, common risks, and the application of formal risk management methods. El Ehwany (2009) explored the challenges that affected the development and competitiveness of the construction sector in Egypt from 1981/1982 to 2006/2007. It also assessed the impact of privatizing ten construction companies on their financial performance, and discussed the benefits and costs of liberalizing construction and related engineering services under GATS. The study concluded that reforming domestic regulations is important as a requirement for enhancing efficiency in the construction sector. However, these papers did not assess the forward and backward linkages of the construction sector using the I/O technique due to data limitations at that time. Accordingly, to the best of our knowledge the topic of construction sector intersectoral linkages and contribution to economic growth has not been thoroughly tackled in Egypt. Thus, the effect of a boom in the construction sector (due to government stimulus packages or heightened construction activity for instance) on other sectors is unidentified for Egypt. From here arises the importance of the present study as a preliminary attempt to investigate the role of such a vital sector in the economy.

In view of this research gap, the purpose of this paper is twofold: firstly, to identify and analyze the supply chain of the construction sector in Egypt with a focus on the size of SMEs and subcontracting in the sector; and secondly, to study the intersectoral linkages of the construction sector and their implications for the Egyptian economy. This will be conducted through an analysis of Egypt's input-output (I/O) tables for the years 2007/2008, 2008/2009 and 2010/2011; in addition to time series analysis of quarterly data for the period starting from 2001/2002 Q1 till 2014/2015 Q2. The I/O analysis captures the aggregate effect of the construction sector on the whole economy through calculating the forward and backward linkages at specific points in time. In addition, it identifies the sectors with high backward linkages to the construction sector. The time series analysis, on the other hand, will identify the impact of construction output on real GDP and a number of sectors' output over time,

chosen according to the highest backward linkages with the construction sector. The time series data is collected from the Ministry of Planning database.

The results of the proposed study will help identify ways to better manage the Egyptian construction sector supply chain and remove the impediments facing firms operating in this vital sector. This is expected to enhance the competitiveness of the construction sector. It will further encourage the role of the private sector, thus freeing up the government resources to other critical areas of expenditure, such as education and health. Furthermore, the development of the construction sector will stimulate other interlinked sectors, boosting real economic growth and job creation.

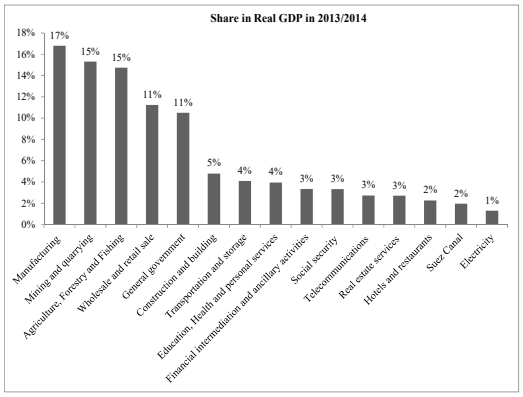
This research paper is organized as follows. After this brief introduction, Section II starts with an overview of the construction sector in the Egyptian economy, highlighting the role of the private sector and SMEs. Section III introduces the supply chain of the Egyptian construction sector. Section IV highlights the linkages of the construction sector to other sectors in the economy through analyzing the I/O tables. The empirical tests for sectoral input linkages to the construction sector are presented in Section V. Section VI empirically investigates the role of the construction sector in economic growth. Finally, Section VII concludes and offers some policy implications.

II. EGYPTIAN CONSTRUCTION SECTOR PROFILE

The construction and building sector is an important axis of development in both developed and developing countries due to its contribution to economic growth and job creation. However, the role of the construction industry in Egypt is still modest with regards to its share in GDP.

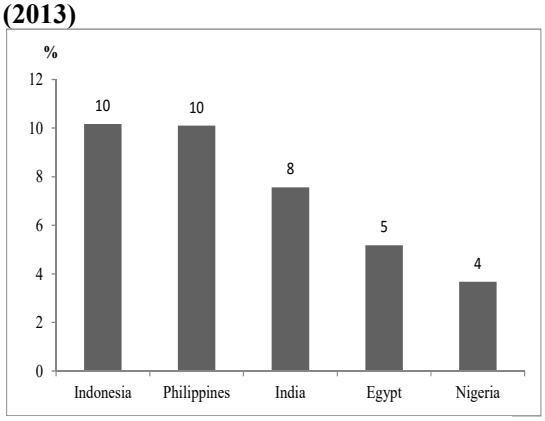
The Egyptian construction industry accounted for 5 percent of GDP on average for the period 2009/2010–2013/2014 and 5 percent of GDP in 2013/2014 (Figure 1). This is considered a low share when compared to other sectors in the economy, namely, manufacturing (17 percent), mining (15 percent) and agriculture sectors (15 percent). Its share is also perceived as modest, in GDP, when compared to the performance of the construction sector in other lower middle income countries (Figure 2).

Figure 1. Economic Sectors' Relative Share in Real GDP in Egypt (2013/2014)



Source: Based on data from the Ministry of Planning.

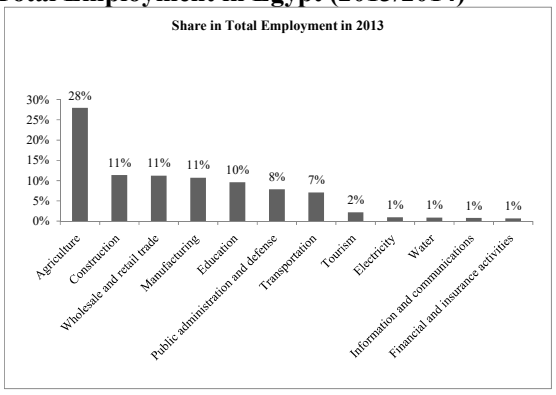
Figure 2. Construction Sector's Relative Share in GDP in a Number of Countries (2013)



Sources: www.tradingeconomics.com, accessed on July 16, 2015; www.kushnirs.org/macroeconomics/prifle.html, accessed on July 30, 2015; country statistics figure - Cunnington, Maren, HamedMadani and MargereetPapamichael. 2014. Countries chosen are lower middle income countries as Egypt with the most recent data for both construction sector output and employment.

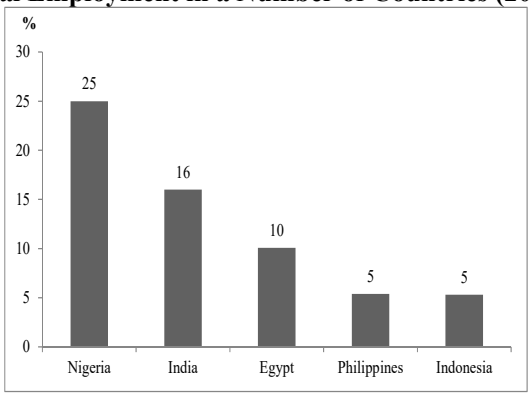
However, its performance differs with regards to its share in total employment. The construction sector accounts for 11 percent of total employment in 2013/2014 and 11 percent on average for the period 2009/2010–2013/2014, with a workforce of 2.7 million people (Figure 3). It is one of the major contributing sectors to employment in Egypt, after the agricultural sector. Yet, compared to other countries, there is still room for further improvement in this level of employment (Figure 4). One of the reasons behind the low contribution to GDP and employment might be a result of the nature of the sector being highly characterized by informality.

Figure 3. Economic Sectors' Relative Share in Total Employment in Egypt (2013/2014)



Source: Based on data from the Ministry of Planning.

Figure 4. Construction Sector's Relative Share in Total Employment in a Number of Countries (2013)

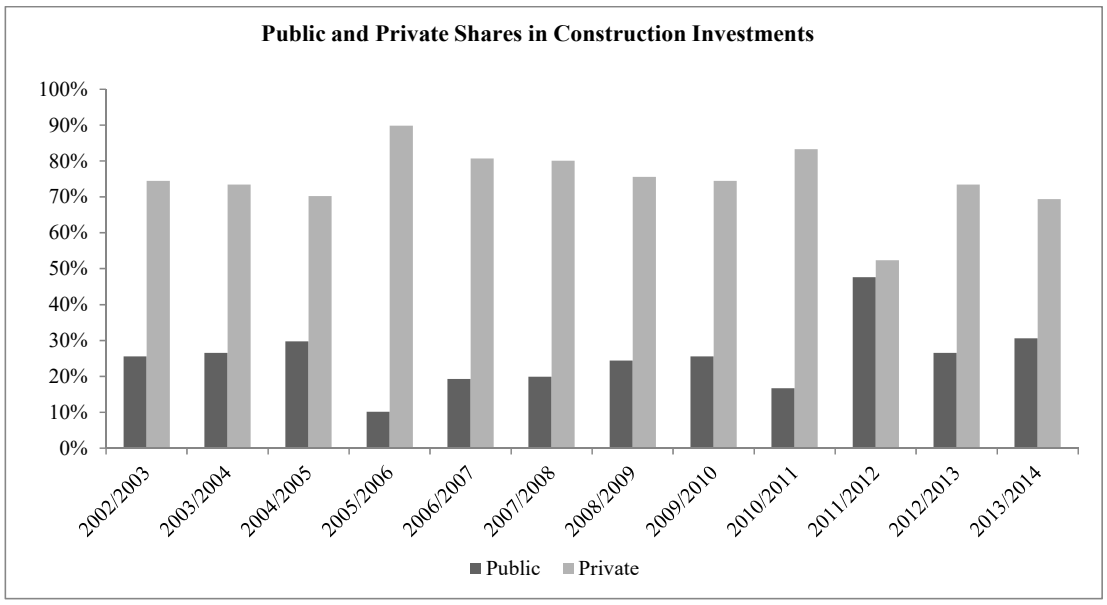


Sources: www.ilo.org, accessed on July 30th 2015; Statistical Bulletin of Construction and Building, 2013, CAPMAS, Egypt; analysis of employment (persons aged 15 - 64) by economic activity (NACE Rev 1 1), 2003 & 2013 (percent of total employment), ec.europa.eu/Eurostat; www.nbcnewss.us/business-news-2013-india-3.html, accessed on July 30th 2015. Countries chosen are lower middle income countries as Egypt with the most recent data for both construction sector output and employment.

The sector has not witnessed severe fluctuations in its share in GDP and total employment over the period of 2009/2010 till 2013/2014. Nevertheless, the fluctuations have been witnessed in the growth rate of the sector, implemented investments and the structure of the public and private sectors' investments. The growth rate of this sector witnessed a drop to 12 percent in 2011/2012. This drop is a reflection of the decline in implemented investments in the sector by almost 71 percent in 2011/2012, due to the country's political conditions at that time. The sector witnessed an improvement in 2012/2013, as investments rose by 92 percent and the growth rate reported an increase to reach 16 percent in the same year.

On average, the private sector contributes by 71 percent to investments in the construction sector while the public sector contributes by 29 percent in the period 2009/2010–2013/2014. The share of the private sector declined from 83 percent in 2010/2011 to 52 percent in 2011/2012. In 2012/2013, the private sector's share increased to 73 percent in total construction investments (Figure 5). This growth in construction investments could be attributed to the optimism of the private sector and regained confidence in the economy.

Figure 5. Public and Private Shares in Construction Investments

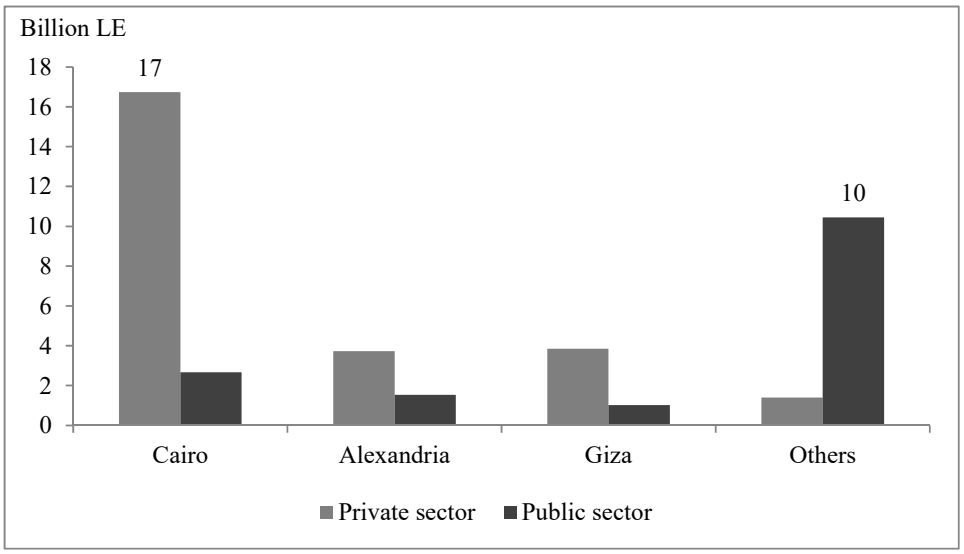


Source: Based on data from the Ministry of Planning.

Hence, private sector investments remained larger than those of the public sector over the period 2009/2010-2013/2014. Regarding geographical concentration, private sector's activity was mainly concentrated in Cairo in 2013. However, public sector activities were mainly concentrated in other governorates (Figure 6). The reason behind the concentration of

the private sector activity in Cairo[3] is the centralization of government ministries and institutions, organizations and major investors in Cairo (Rakodi 1997). In addition, the regulations governing the construction sector are not applied evenly across the governorates. For instance, preconstruction approvals time varies between governorates. Additionally, fees associated with building approvals vary from city to city. In some cities, applicants are subject to charges not required by national law (World Bank 2013). These cumbersome procedures make it harder for the private sector to align its business activities across governorates.

Figure 6. Production by Sector and Governorate in 2013



Sources: CAPMAS (2013a, 2013b).

With regards to firm size, construction activity in both the private and public sectors is concentrated in large firms. Most of the work of the private sector is implemented by large firms, which account for 70 percent of total contracts and 76 percent of total value added (Table 1). This is despite the fact that 95 percent of private sector firms are small and medium sized (Table 6). Regarding the public sector, 99 percent of the total value added is in large firms (Table 2). This signals that the sector is mainly dominated by large firms and the role of SMEs is undermined. This minor role for SMEs can be attributed to the nature of informality and subcontracting in this sector.

[3] It is also easier to start a business in Cairo, Giza and Alexandria where the three cities have a rank of 1 in the indicator of starting a business in the doing business report of Egypt for 2014, while it is more cumbersome to start a business in other cities in Egypt (World Bank 2013).

Table 1. Value Added of Private Construction Firms According to Firm Size in 2013

In thousand LE	Value added	Share of firms in TVA of the private sector (%)
Less than 500 employees	**3,081,824**	**24**
More than 500 employees	**9,517,311**	**76**
From 500 till 2999	3,013,830	24
From 3000 till 5000	3,072,451	24
More than 5000	3,431,030	27
Total	**12,599,135**	**100**

Source: Data obtained from the Central Agency for Public Mobilization and Statistics (CAPMAS).

Note: This paper considers firms with less than 500 employees as small and medium firms due to the labor intensity of the sector.

Table 2. Value Added of Public Construction Firms According to Firm Size in 2012/2013

In thousand LE	Value added	Share of firms in TVA of the public sector
Less than 500 employees	34,340	1%
More than 500 employees	3,566,560	99%
From 500 till 2999	1,007,437	28%
From 3000 till 5000	614,360	17%
More than 5000	1,944,763	54%
Total	3,600,900	100%

Source: Data obtained from CAPMAS.

Figures 7 and 8 compare the construction operations of private and public sectors. Residential private construction work accounts for 27 percent of total private sector construction work, while only 6 percent of public sector construction work is residential. Petroleum private construction activities represent the largest share of private sector construction work, while infrastructure represents the major construction work in the public sector. It is noted that the share of infrastructure in total private sector projects is small relative to that of the public sector. It is therefore recommended that infrastructure is built in coordination with the private sector to avail more funding and free up government resources and to achieve higher efficiency. This can be done through implementation of public private partnerships.

Figure 7. Private Sector Operations for the Year 2013

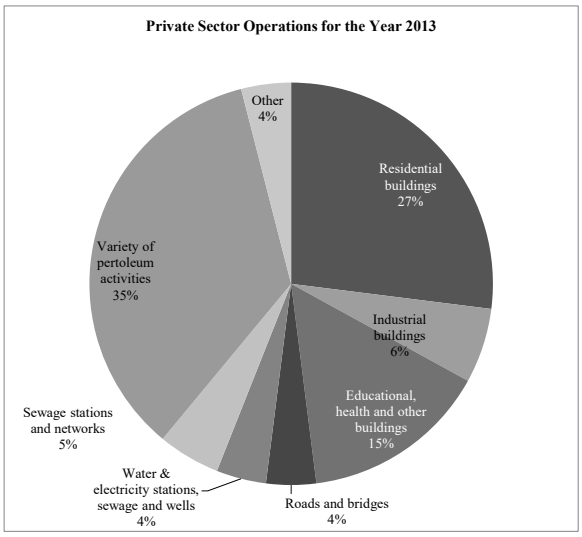
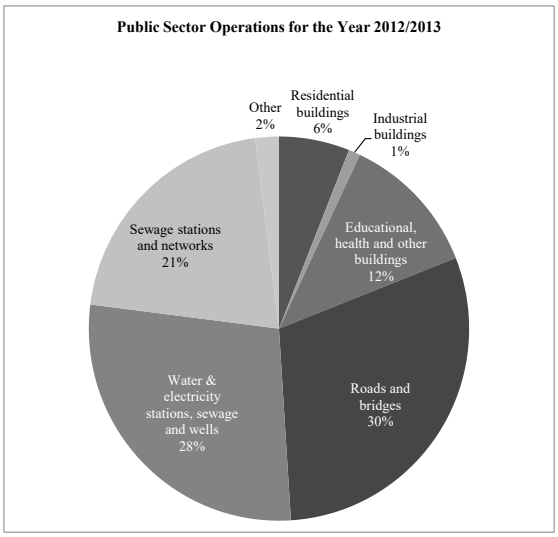


Figure 8. Public Sector Operations for the Year 2012/2013



Sources: CAPMAS (2013a, 2013b).

The overall outlook for construction is perceived to be positive. The sector is expected to grow at an unprecedented rate in the coming years due to strong demand for infrastructure projects as well as residential and nonresidential buildings. Infrastructure projects include the new Suez Canal development project, the development of Cairo airport, the new nuclear plant in El Dabaa and a couple of energy and transportation projects according to the GoE plan 2015/2016. Residential and non-residential buildings include plans to construct a new capital city and build one million housing units for low income citizens. In addition, the government is planning to double investments targeted to develop the slums with an investment of one billion Egyptian pounds according to the plan of 2015/2016 (Ministry of Planning and Follow-up and Administrative Reform 2015). These are some examples of increased activities in the construction sector in the upcoming period, which will eventually translate into increased growth of the sector. A major part of these projects is expected to be implemented by the private sector, as the government targets stimulating private investments in this sector.

To sum up, the contribution of the Egyptian construction sector to GDP and employment is modest compared to its level in other lower middle income countries. The sector is mainly driven by government projects and growing population. This demand is

mostly catered by the private sector and large firms. Private sector activities are concentrated in Cairo while those of the public sector are concentrated in other governorates.

III. CONSTRUCTION SECTOR SUPPLY CHAIN

A supply chain is a network of all stakeholders in contact with a particular product, such as suppliers, manufacturers, distributors and retailers. It integrates all the activities, upstream and downstream, required to produce a good and deliver it to the end customer. The supply chain also entails flow of information, materials and funds. Information flows are the orders of producing a certain product and the schedule/timeline for producing it. The material flows include the supplies and raw materials needed to produce a certain product, as well as the production and delivery of the final product. Fund flows are the flow of payment and financing from financial intermediaries. The supply chain thus depicts every interaction related to the production of a certain product, the stakeholders and the flows involved (Isatto and Formoso 2011).

From a construction project perspective, the supply chain is different than that of the manufacturing sector in a number of ways. In the manufacturing sector, every product is produced in a separate plant and then transmitted to another plant to produce the final product. In addition, there is an established production line that is repeated every time there is demand to produce this product. On the contrary, in the construction sector, the product is produced on site and all materials are delivered to the construction site, where the building is assembled from these materials. This is called a converging supply chain (London and Chen 2006).

The construction sector supply chain is a make-to-order, where every project is unique according to its nature, size and final use. Make-to-order is a process in which the assembly starts only after a customer's order is received. In other words, an assembly process begins when demand actually occurs. This means to start a pull-type supply chain operation because the construction activity is performed when demand is confirmed, hence being pulled by demand. Pull-type production is a business model of the assembly industry in which the quantity to produce per product specification is one or only a few, like construction and plant construction (Alves, Tommelein, and Ballard 2005). The supply chain of the construction sector thus starts with the buyer/owner of the project unlike the manufacturing sector where the supply chain ends with the buyer. In addition, the construction sector supply chain is characterized by a large number of interdependent firms. Thus, it is characterized by

convergence and uniqueness of each and every project. This highlights the importance of depicting the supply chain of the construction sector.

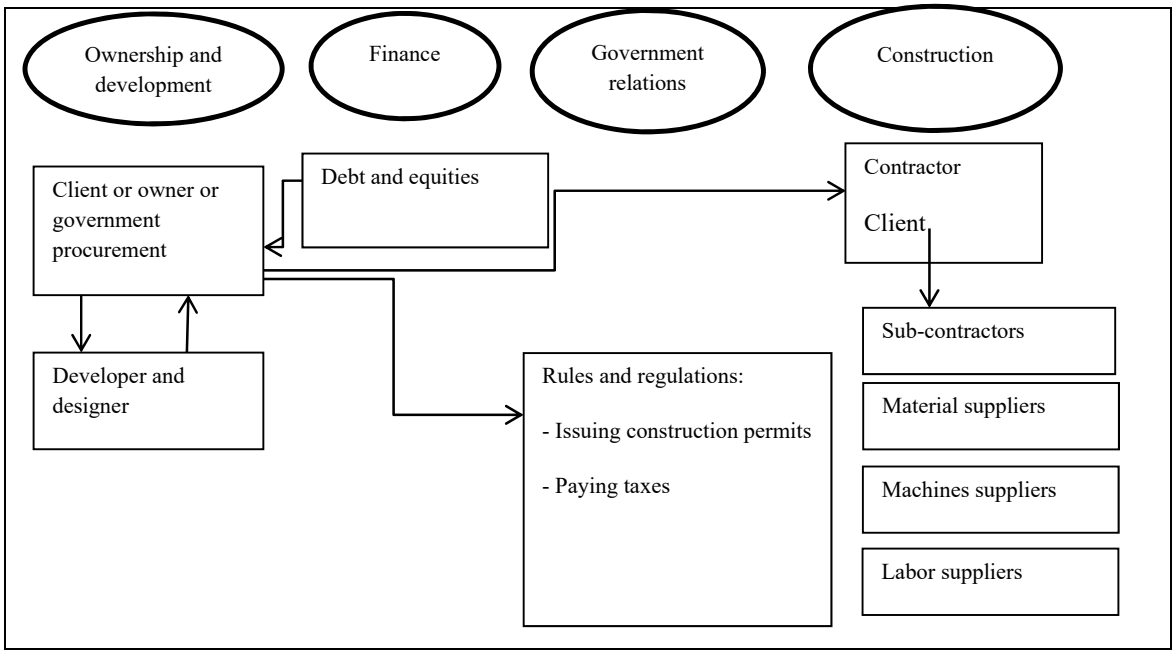
The construction sector supply chain, as depicted in Figure 9, is divided into three phases: the preconstruction phase, the construction phase and the post-construction phase. The preconstruction phase includes ownership, development, financing and government relations. It starts by a demand from the client or owner of a certain construction project followed by designing the project by designers, and then financing the project through investors and/or banks. Meanwhile, construction permits are issued through the government entities. Afterwards, the construction phase starts, which includes construction, maintenance, and demolition of projects. This phase involves contractors, subcontractors and suppliers of labor, machines and materials (i.e., steel and cement). The contracting procedure often differs according to the nature and size of the project at hand (Assaad and Tunali 1992).

In the post-construction phase, brokers are involved to sell or lease projects depending on the tenant's use (i.e., commercial, industrial or residential) (El Nakeeb 2010). In case the owner is the final user, no broker would be involved. These stages are further elaborated later in this section.

The analysis will start with government relations, highlighting issuing construction permits and the laws governing this sector. According to the World Bank (2016), issuance of construction permits requires 20 procedures, takes 179 days and costs 1.7 percent of the warehouse value. The number of procedures required to issue a permit is higher than the average of the Middle East and North Africa representing 14.8 procedures, taking only 139.7 days. However, the cost for the MENA region is higher than that of Egypt representing 3.1 percent.[4] This is the result of introducing a flat fee of LE 2,000 to register a property with the Real Estate Registry according to Law 83 of 2006 on real estate tax. This reform significantly decreased the total costs of issuing permits. As a result, in Egypt the permitting process is relatively cheap compared to other economies in the Middle East and North Africa.

[4] World Bank (2013) records the procedures, time and cost required for a small to medium-sized business to obtain all the necessary approvals to build a simple commercial warehouse and connect it to water, sewerage and a fixed telephone line.

Figure 9. Construction Sector Supply Chain



Source: Constructed by researchers based on supply chains presented in AbdelHamid et al. 2014.

The Unified Building Law 119 of 2008 and its Executive Regulations of 2009 comprise the regulatory and legal framework of the construction-permitting process across Egypt. The Law does not determine the number of inspections during construction. Their frequency remains under the discretion of municipal engineering departments. Furthermore, the Unified Building Law of 2008 has not been evenly implemented across the country.

Complex, costly and discretionary building procedures are associated with higher levels of informality. Informality in construction ranges between 60 percent and 80 percent in developing countries. This means a loss of revenues for governments, jeopardizing the safety of the public and constraining the use of real estate as collateral for finance (World Bank 2013).

Construction permitting is a regulatory area prone to corruption. Where the construction permitting process is less cumbersome, the level of corruption declines. Small and medium-sized businesses with no power or influence are more vulnerable. In Egypt, 85 percent of

firms identify corruption as a serious problem. Reforms making it easier to deal with construction permits help the growth of the construction industry. Consequently, more construction workers are employed, construction-related materials and services are purchased from local suppliers, and local jobs are created. For every ten jobs directly related to a construction project, eight other jobs may be created in the local economy (World Bank 2013).

Getting back to ownership and development in the preconstruction phase, some owners form their own construction companies to do their own work. This is considered advantageous in the sense of ensuring a consistently high standard of work and flexibility. Other owners depend on external construction firms. In this case, the construction company could be selected for a design and build project or build only projects. In the design and build projects, the construction firm will be involved in the early planning stage of designing until the completion of the project. In the build-only projects, the owner will hire a designer to design the project and the construction company will be responsible for building the designed project. In both cases, the construction firm will provide comprehensive management of the project, including time, cost and quality. The construction firm can act as the main contractor or can sign a contract with a general contractor (BIS 2013).

The selection of the general contractor depends on two main factors, namely, the company's experience in similar projects and its financial capability. Other factors that are considered important include the firm's structure, organization and its capacity (i.e., the projects in process). Regarding the technical analysis of the contractor's ability to perform, the quality assurance system of the contractor is considered. This is in addition to the adequacy of the technical supervision and the availability of equipment (Salama et al. 2006). These criteria for selection of a contractor posit a natural barrier on SMEs' access to the market, due to the financial constraints they usually face. SMEs do not have sufficient resources to purchase the necessary equipment and avail a good quality of assurance.

General contractors manage and hire subcontractors while act as the primary contact with construction clients. Subcontracting appears more in the public sector, rather than in the private sector. Specifically, subcontracts represent 28 percent in the public sector versus only 7 percent in the private sector, as depicted in Table 3. It might be the case that firms do not explicitly specify their subcontracting activities due to their informal nature.

Table 3. Share of Original Contracts and Subcontracts by Public and the Private Sectors in 2013

Contract Type	Value in thousand LE		Share	
	Private sector 2013	Public sector 2012/2013	Private sector ٢٠١٣	Public sector 2012/2013
Total	50,554,310	15,675,675		
- Original	46,944,793	11,333,872	93%	72%
- Subcontract	3,609,517	4,341,803	7%	28%

Sources: CAPMAS (2013a, 2013b).

Table 4 further shows the share of subcontracts according to firm size in the private sector. The subcontracts are more used in the small and medium firms in comparison to large firms. The private small and medium firms reported that 14 percent of their contracts are of sub-contractual nature; while the subcontracts in the large private firms represented only 2 percent. The same trend is witnessed in the public firms where the subcontracts represent 15 percent of the contracts of the small and medium firms and 6 percent for large firms (Table 5).

Table 4. Share of Original Contracts and Subcontracts by the Private Sector in 2013 According to Firm Size

In thousand LE	Original contracts	Subcontracts	Share of subcontracts in total contracts
Less than 500 employees	**6,692,890**	**1,073,271**	**14%**
More than 500 employees	**17,657,339**	**300,325**	**2%**
From 500 till 2999	8,416,547	300,325	3%
From 3000 till 5000	2,963,458	0	0%
More than 5000	6,277,334	0	0%
Total	**24,350,229**	**1,373,596**	**5%**

Source: Data obtained from CAPMAS.

Table 5. Share of Original Contracts and Subcontracts by the Public Sector in 2012/2013 according to Firm Size

In thousand LE	Original contracts	Subcontracts	Share of subcontracts in total contracts by firm size
Less than 500 employees	207,421	36,194	15%

More than 500 employees	12,916,374	857,513	6%
From 500 till 2999	2,877,753	33,131	1%
From 3000 till 5000	1,714,207	-	0%
More than 5000	8,324,414	824,382	9%
Total	13,123,795	893,707	6%

Source: Data obtained from CAPMAS.

The construction phase is divided into a number of tasks that are performed in a particular sequence, including site preparation, installations, plumbing, etc.

Table 7 reports the number of private and public construction firms according to the construction specialization in the production process. The construction activity is dominated by the private sector. Most of the private sector firms are specialized in building and utility projects. It is important to note that these numbers underestimate the true size of this sector. A large number of the establishments in this sector are informal and hence are not recorded. Moreover, in the private sector, most of the construction firms are small and medium firms with less than 500 employees as shown in Table 6.

Table 6. Number of Construction Firms According to Firm Size

	Public sector 2012/2013	**Private sector 2013**
Less than 500 employees	3	503
more than 500 employees	20	26
from 500 till 2999	15	19
from 3000 till 5000	2	2
more than 5000	3	5
Total	23	529

Source: Data obtained from CAPMAS.

Table 7. Number of Private and Public Construction Firms According to their Economic Activity/Specialization in 2013

	Public Sector	**Private Sector**
Buildings	10	289
Roads and railways	4	32
Utility projects	5	100
Engineering projects	3	12
Other construction assembly work	1	17
Demolition		1
Site preparation		4
Installation of electrical devices		22
Installation of plumbing and heating systems and air-conditioning		16

Finishing of the construction work		17
Others		19
Total	23	529

Sources: CAPMAS (2013a, 2013b).

Tenders Law 89 of 1998 governs foreign companies, bids on public tenders and regulating all supply, service and construction contracts with the Egyptian government. The law was amended in September 2006; among the changes is lowering charges for tender documents (no cost for SMEs). Contracts with the government are normally through public tenders or by public negotiations between the government entity and the contractor. Exceptions to this are the limited tender, limited negotiations and direct contracting.[5] Hence, material suppliers can be chosen using a public tender, request quotes, or direct order purchase. Most of the government and public sector companies prefer the public tender method, while the private sector companies prefer the request quotes (AbdelHamid et al. 2014).

The tenders' law is expected to be amended soon to overcome the problems that happened during enforcement, including the time it takes to clear the IPO and the settlements. In addition, the amendment will cover the increase in costs after the settlement where the contractor asks for increasing the value of assignment orders.

Table 8 shows the value of raw materials used in the construction activity by both the private and public sector. It is noted that the construction and building sector is linked to a number of other industries and services estimated to be around 90 industries. These industries include cement, steel, concrete and pipes.

In hiring labor force used in a project, the general contractor uses a subcontractor (Assaad and Tunali 1992). The subcontractor hires the technicians and specialists responsible for plumbing, heating and air conditioning, painting or roofing aspects of the construction project. The technicians and specialists represent 12 percent of the labor force in both the private and public sector. In the private sector, construction workers represent 51 percent of

[5] The limited tender is used with certain types of consultants, contractors, suppliers, or technicians, whether in Egypt or abroad according to the nature of the contract; the local tender is implemented whereby all contracts worth up to LE 200,000 are reserved for Egyptian suppliers; limited negotiations is generally used for manufactured items that are available only from certain contractors or production locations, for technical works requiring certain specialists, and where confidentiality is needed for national security constraints; and direct contracting is used in extraordinary cases.

the workforce. Most of the construction workers and specialists in this sector are hired informally (almost 90 percent are informal workers) where subcontractors are used to hire a flexible workforce (refer to Figures 10 and 11), (Othman and Mahfouz 2011).

Table 8. Value of Raw Materials Used in Production by Sector for the Year 2013

In billion LE

Raw Materials	Private Sector	Public Sector
Pipes	1.09	0.44
Rebar	0.83	0.81
Cement	0.55	0.27
Metal tools	0.49	0.03
Electrical appliances	0.44	0.13
Sand and gravel	0.24	0.33
Sanitary ware	0.23	0.12
Walls and ready mix concrete	0.22	0.07
Bricks	0.18	0.06
Tiles	0.18	0.03
Wood	0.02	0.04
Other	5.06	1.54
Total	**9.51**	**3.85**

Sources: CAPMAS (2013a, 2013b).

Figure 10. Share of Employees in the Private Sector by Occupation for 2013

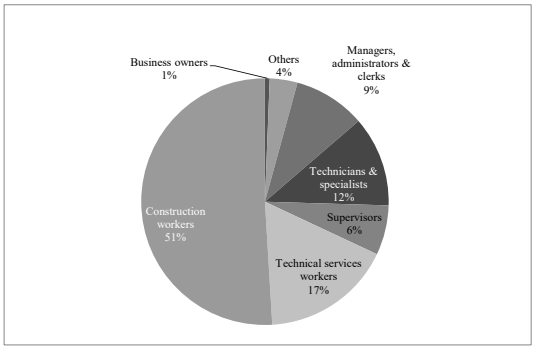
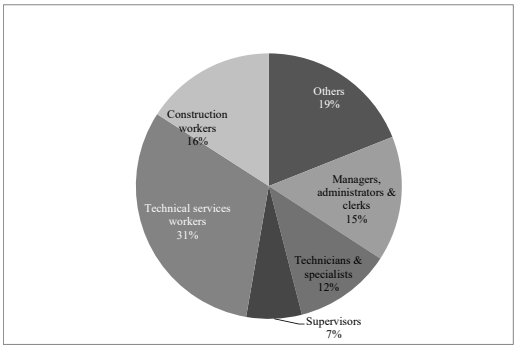


Figure 11. Share of Employees in the Public Sector by Occupation for 2012/2013



Sources: CAPMAS (2013a, 2013b).

IV. INPUT-OUTPUT TABLE ANALYSIS: FORWARD AND BACKWARD LINKAGES OF THE CONSTRUCTION SECTOR

In light of the importance of the construction sector in the Egyptian economy (in terms of its contribution to total employment and its potential increased share in GDP), there is a need to understand its interlinkages and multiplier effect on other sectors. The identification of inter-sectoral linkages is a reliable tool to enhance the output of the economy. For this purpose, the forward and backward linkages of the construction sector are computed through employing the I/O tables in current prices for years 2007/2008, 2008/2009 and 2010/2011 issued by the Ministry of Planning and CAPMAS.[6] It is crucial to note that the output of the construction sector is expected to be underestimated due to informality. Although construction is a very pervasive activity undertaken by almost every residential owner and business entity, yet these private construction activities are only partially captured by official statistics (Song, Liu, and Langston 2008).

The linkage indicators are used by many development economists to identify key sectors. These are the sectors with strong total forward and backward linkages. Hence, a sector that has a total forward and backward linkages indicator greater than one is considered a key sector. There are also other sectors, which nearly qualify as key sectors; the linkages indices for these sectors lie between 0.9 and 1. On the other hand, a weak linkage index is below 0.9 (Soofi 1992).

In light of Hirschman's (1958) theory of development, the optimistic view suggests treating the key sectors on priority basis. Applying this criterion, the Egyptian construction sector can be considered a key sector in the 3 years covered by the study. The linkages of the Egyptian construction sector are shown in Table 10. Direct intermediate inputs into the construction sector represent 51.4 percent of total inputs in 2010/2011. It is known that the

[6] Two matrices will be constructed to determine the inter-sectoral linkages of the construction sector. The first matrix is the direct technical coefficient matrix. It is generated by dividing each flow shown in the I/O table by its column/row sum. Depending on the technical coefficients matrix, the direct forward and backward linkages will be calculated. The backward and forward linkages of a sector are calculated using the sum of the columns and rows of technical coefficient matrix. This method accounts for only direct input (or output) coefficients and ignores the indirect effect of inter-sectoral linkages in the production process. Therefore, it represents the first round effects resulting from the interrelationships between the sectors (Chenery and Watanabe 1958). The second matrix is the Leontief inverse matrix. In order to obtain the Leontief inverse, the direct technical coefficient matrix is subtracted from the identity matrix and the resulting matrix is inverted to obtain the total coefficient matrix, $(I-A)^{-1}$. The elements of the Leontief inverse matrix indicate the total flows between two sectors (including both direct and indirect flows). The column and row sums of the Leontief inverse matrix measure the total, both direct and indirect, as well as backward and forward linkages. The total backward linkage indicators are known as output multipliers, while the total forward linkage indicators are known as input multipliers. A higher backward linkage indicates the economic pull effect of the construction sector, while the forward linkage indicates its economic push effect (Rameezdeen and Zainudeen 1994).

higher the backward linkage a sector has, the more important that sector is in promoting economic growth. This is because it indicates the sector's capability in increasing the other sectors' output. Specifically, it means that the sector needs a large amount of national purchases from other sectors. The values of total (direct and indirect) backward linkages are also calculated. The backward linkages are relatively high for the construction sector as shown in Table 9). This high value indicates that there is a large direct and indirect effect for a given increase in final demand for the products of the construction sector. The value of both the direct and total backward linkages increased in 2008/2009 relative to 2007/2008.This could be attributed to the heightened level of construction activity in this year. However, they slightly declined in 2010/2011 due to the political instability in that year.

Table 9. Backward Linkages of the Construction Sector (2007/2008, 2008/2009 and 2010/2011)

Indicator	2007/2008	2008/2009	2010/2011
Direct backward linkage	0.426	0.589	0.514
Total backward linkage	1.637	2.196	1.937
Power of dispersion[7]	1.116	1.42	1.245
Coefficient of variation of total backward linkages	2.125	2.328	2.505

Source: Authors' calculations based on the I/O tables for the years 2007/2008, 2008/2009 and 2010/2011.

The high output multiplier indicates the capability of the construction sector to stimulate production in other sectors linked to it. This illustrates the nature of the construction operations being the assembly of many products purchased from a large number of manufacturers. The backward linkage induces growth through the process of derived demand, because the remaining sectors will face losses in the absence of purchases of the construction sector. Hence, the construction sector represents a strong economic pull to the remaining sectors and eventually the national economy (Song, Liu, and Langston 2004).

The power of dispersion reflects the effect of one unit increase in final demand in the construction sector on overall economic activity. It is the extent to which the total backward linkage of the sector is greater than the average total backward linkage. A value greater than one indicates that the industry is characterized by backward linkages higher than the average backward linkage for the whole economy. The value of the power of dispersion for the

[7] Power of dispersion is the sum of any column in the inverse coefficient matrix divided by the mean value of entire vertical sum in the inverse coefficient matrix.

construction sector is greater than 1 for the three years under study and is exhibiting the same trend as the total and direct backward linkages. This indicates that the construction backward linkage is higher than the average backward linkage in Egypt over the concerned years.

The coefficient of variation is the extent to which a sector draws its inputs uniformly from all sectors. A high value indicates that a given sector draws unilaterally on other sectors (i.e., draws heavily on a small number of sectors), while a low value means that it draws evenly on them. This measure normally ranges from 2.09 to 5.98 for developing countries (Ashwani and Vashist 2012). The construction sector in Egypt has a low coefficient of variation of total backward linkages indicating that it draws its inputs evenly from other sectors. This implies that the effect of the construction sector is widespread across the sectors of the economy since it uses inputs evenly from all the sectors.

Table 10 compares total backward linkages of the construction sector with other sectors' performance. The construction sector's rank in 2010/2011 is the fourth after electricity, manufacturing and tourism. The real estate activities had the lowest total backward linkages in that year. This result is in line with the results of the power of dispersion showing a high backward linkage in comparison to other sectors in the economy. It indicates the importance of the sector in stimulating production in other sectors, showing the potential of increasing the output of other sectors as a result of increasing investment in the construction sector.

Table 10. Comparison of Total Backward Linkages

Total backward linkages	**2007/2008**	**2008/2009**	**2010/2011**
Minimum	1.115	1.10	1.09
Maximum	1.820	2.22	2.39
Average	1.466	1.54	1.56
Construction sector	**1.637**	**2.196**	**1.937**

Source: Authors' calculations based on the I/O tables for 2007/2008, 2008/2009 and 2010/2011.

Table 11 shows the sectoral input linkage indicators to the construction sector in 2010/2011. The main suppliers of the construction sector are the manufacturing sector followed by the financial and insurance activities, mining and quarrying, and wholesale and retail trade. The manufacturing sector is the main supplier of inputs for the construction sector; this explains the high input linkage between the two sectors. The relationship between financial services and the construction sector is clear in depending on banks to provide credit for construction activities in addition to using property as collateral to take loans. So it goes

both ways in the financial sector. Hence, in order to stimulate the output of the construction sector, it is important to facilitate the lending activities, especially to the private sector and SMEs and encourage investment in manufacturing activities to avail the necessary inputs necessary for growth of this crucial sector.

Table 11. Sectoral Input Linkage Indicators to the Construction Sector in 2010/2011

	Direct	Total
Agriculture, forestry and fishing	0.000	0.042449
Mining and quarrying	0.012	0.092506
Manufacturing	0.210	0.382847
Electricity, gas, steam and air conditioning supply	0.001	0.014926
Construction	0.138	1.160345
Wholesale and retail trade; repair of motor vehicles and motorcycles	0.028	0.052929
Transportation and storage	0.014	0.029477
Accommodation and food service activities	0.003	0.006458
Information and communications	0.004	0.006451
Financial and insurance activities	0.072	0.091971
Real estate activities	0.001	0.004346
Professional, scientific and technical activities	0.015	0.022114
Administrative and support service activities	0.016	0.022558
Public administration and defense; compulsory social security	0.000	0.000141
Education	0.000	0.002713
Human health and social work activities	0.000	0.000604
Arts, entertainment and recreation	0.000	0.002111
Other service activities and activities of households	0.001	0.002051

Source: Authors' calculations based on the I/O table for 2010/2011.

The forward linkages for construction are lower than the backward ones over the three examined years. This result is consistent with the result of the sensitivity of dispersion. The sensitivity of dispersion reflects the effects of one unit increase in production of the construction sector on overall economic activity. A sector with an index value of more than one means that it has sensitivity of dispersion greater than the average of all industries. The construction sector recorded a sensitivity of dispersion less than one. This shows that the construction sector provides its output to a small range of industries and its influence on the economy as a supplier was less than the average of all industries.

The relatively low input multiplier, of 1.229 (low value when compared to the average total forward linkages in Egypt for all sectors, Table 13), implies that the major share of construction output (about 82 percent) supplies final demand, which represents new

construction (refer to Table 13). The forward linkages of the construction sector consist mainly of repair and maintenance activities. In addition, these repair and maintenance activities could be underestimated in the official statistics due to the existence of black market and "do it yourself" activities (informal settlements and activities). The repair and maintenance activities are relatively lower/negligible in developing countries where the most prevalent activities are new construction. This explains the weak economic push effect of the construction sector on Egypt's economy. New building investment is expected to have a more positive impact on the economy as a whole and the real estate sector in particular than the remodeling (repair and maintenance). Nevertheless, the poor performance of repair and maintenance results in catastrophes (collapsing buildings in many areas in Egypt). Building and planning authorities will need to enforce the construction and safety regulations, especially in repair and maintenance areas.

Table 12. Forward Linkages of the Construction Sector (2007/2008, 2008/2009 and 2010/2011)

Indicator	2007/2008	2008/2009	2010/2011
Direct forward linkage	0.076	0.130	0.187
Total forward linkage	1.092	1.683	1.229
Sensitivity of dispersion[8]	0.7449	0.756	0.79

Source: Authors' calculations based on the I/O tables for the years 2007/2008, 2008/2009 and 2010/2011.

Table 13. The Composition of Forward Linkages for the Construction Sector (2010/2011)

Components of total demand in 2010/2011	Share
- Total intermediate demand	**16%**
- Total final demand	**82%**
Total final consumption expenditure	3%
Gross capital formation	94%
Total exports	3%

Source: Authors' calculations based on the I/O table for 2010/2011.

Table 14 compares the total forward linkages of the construction sector with other sectors. It can be seen that it is below the average of the other sectors. Its rank in 2010/2011 is the 9th. The manufacturing sector has the highest total forward linkages, while public administration and defense have the lowest.

Table 14. Comparison of Total Forward Linkages

[8] Sensitivity of dispersion is defined as the sum of the row in inverse coefficient matrix divided by the mean value of the entire horizontal sum in inverse coefficient matrix.

Total forward linkages	2007/2008	2008/2009	2010/2011
Minimum	1.029	1.01	1.03
Maximum	2.904	4.96	4.82
Average	1.466	2.74	2.78
Construction sector	**1.092**	**1.683**	**1.229**

Source: Authors' calculations based on the I/O tables for 2007/2008, 2008/2009 and 2010/2011.
Note: 2007/2008 has a different definition of the sectors.

V. EMPIRICAL TESTS FOR SECTORAL INPUT LINKAGES TO THE CONSTRUCTION SECTOR

The previous input output analysis indicated that the construction sector has above average total backward linkages, with the main suppliers being the manufacturing, financial and insurance activities, mining and quarrying, as well as wholesale and retail trade sectors. Accordingly, this section is designed to estimate an empirical model that incorporates the linkages among the construction sector and these aforementioned sectors. The purpose of the model is to analyze the intersectoral linkages among these sectors both in the long and short terms.

Data and Methodology

In an attempt to assess the construction sector's main backward linkages, the analysis focuses on the log of five variables, namely construction output, manufacturing output, financial and insurance activities output, mining and quarrying output, and wholesale and retail trade output. All variables are measured in real 2011/2012 prices. The study uses quarterly data for these variables for the period 2001/2002: Q1 to 2014/2015: Q2. The data is taken from the Ministry of Planning.

In order to quantify the intersectoral linkages between the sectors of interest, the following endogenous model is employed (Subramanian and Reed 2009):

$$G_i = f(const, man, fin\_ins, \min\_quar, wsale\_ret) \quad (1)$$

where G_i: log growth of the economic sector i.

const: log of construction output.

man: log of manufacturing output.

fin_ins: log of financial intermediation and insurance activities output.

min_quar: log of mining and quarrying output.

wsale_ret: log of wholesale and retail trade output.

Econometric Procedures

Testing for stationarity

An econometric analysis usually starts with univariate analysis for the variables included in the model. The accurate univariate analysis is a prerequisite for the implementation of the multivariate one. Employing non-stationary variables in a model results in a spurious regression. Moreover, the right order of integration of each variable, with the appropriate lag length, should be determined in order to proceed with the analysis. The Augmented Dickey-Fuller (ADF) test will be employed to check for the stationarity of the variables under study (Dickey and Fuller 1979). The test is undertaken through the following equation:

$$\Delta Y_t = \alpha + \beta t + (\rho - 1)Y_{t-1} + \sum_{j=1}^{p} \gamma_j \Delta Y_{t-1} + \varepsilon_t \qquad (2)$$

where Y_t will be replaced by each of the model's variables, t refers to the trend and j refers to the number of lags. The number of lags is chosen to minimize Akaike Information Criterion (AIC) and/or Schwartz Bayesian Criterion (SBC) and ensure there is no serial correlation. The null hypothesis of ADF test is $\beta = 0 \; and \; \rho = 1$ indicating a non-stationary variable. The null hypothesis will be rejected, indicating that the variable is stationary, if the estimated absolute value of the ADF test statistic is greater than Mackinnon absolute critical values. The analysis showed that all variables failed to reject the unit root hypothesis at levels. However, this hypothesis was rejected at first differences, indicating that all variables are integrated of order one.

Table 15. ADF Test Results

	Variables	**ADF [No. of Lags]**
A. Series in levels	const	2.55[4]
	man	-2.01[4]
	fin_ins	2.21[4]
	min_quar	0.624[4]
	wsale_ret	5.162[3]
B. Series in first differences	Δconst	-3.1* [3]
	Δman	- 2.77* [3]

	Δfin_ins	-2.17* [3]
	Δmin_quar	-2.52* [3]
	Δwsale_ret	-31.12* [2]

Notes: (1) An * indicates rejection of the null hypothesis of non–stationarity at the 5 percent level of significance using Mackinnon (1991) critical values. (2) ADF [p] is the Augmented Dickey–Fuller test; it gives the t–statistics from a specification that includes either an intercept or none, and p lagged changes in the dependent variable.

Johansen Cointegration Test

The previous results show that all the variables are non-stationary at levels and integrated of order 1. Thus, we can proceed with carrying out Johansen's (1988) maximum likelihood cointegration test to investigate the presence of a long-run relationship among the variables. Two non-stationary variables can be co-integrated if a linear combination of those variables is stationary (Engle and Granger 1987). We start by running the unrestricted VAR in levels in order to specify the appropriate lag length. Using Schwartz criterion, the lag length was found to be 2. Statistical results of the Johansen test for cointegration are summarized in Table 16.

Table 16. Johansen Cointegration Test Results

Hypothesized No. of CE(s)	Maximum Eigen Value Statistic	Eigen Value	0.05 Critical Value
None*	52.42680	0.642270	33.87687
At most 1	26.82842	0.409064	27.58434
At most 2	13.64626	0.234766	21.13162
At most 3	4.701344	0.088062	14.26460

Notes: Cointegration test indicates 1 cointegrating equation (s) at the 0.05 level.
* denotes rejection of the hypothesis at the 0.05 level.

The maximum eigen value statistic indicates that there is one co-integrating equation at 5 percent significance level. This implies the existence of a unique equilibrium relation between outputs of these sectors in the long run. The same result was reached using the trace statistic. The estimated long-run relationship is given as follows:

$$const = -4.3 - 0.126man + 0.619\,fin\_ins - 0.048\min\_quar + 1.44wsale\_ret \qquad (3)$$

(-0.786) (6.26) (-0.639) (10.11)

The numbers in parenthesis are the t-statistics. At 5 percent significance level, only the financial intermediation and insurance activities, and the wholesale and retail trade sectors were found significant. This indicates that these sectors have significant long-term relationships with the construction sector output. The financial intermediation and insurance activities sector as well as the wholesale and retail trading sector both appear to be positively associated with the construction sector. This is quite expected, since the flourishing of the financial intermediation and insurance activities sector indicates the availability of enough liquidity to finance the construction sector activities. Also, the development of the construction sector enhances trading activities and creates job opportunities. This will probably be reflected in availing more liquidity in the financial sector. The same applies to the wholesale and retail trading sector. Its increased activities are expected to be reflected on the activities of the construction sector and vice versa. The insignificance of the manufacturing sector, despite high backward linkages of the construction sector with the manufacturing one, could be attributed to the possible multicollinearity between the explanatory variables.

In order to formally decide upon the direction of the relation between pair wise sectors, we conduct a Granger causality test for the variables in their stationary state (that is, first differenced). The results are reported in Table 17.

Table 17. Granger Causality between Construction, Manufacturing, Financial and Insurance, Mining and Quarrying, and Wholesale and Retail Trade Sectors

Null Hypothesis:	Lag Order#	F-Statistic	Prob.
D(LMAN) does not Granger Cause D(LCONST)	2	1.86560	0.1663
D(LCONST) does not Granger Cause D(LMAN)		0.23055	0.7950
D(LFIN_INS) does not Granger Cause D(LCONST)*	2	5.46211	0.0074
D(LCONST) does not Granger Cause D(LFIN_INS)*		14.4877	1.E-05
D(LMIN_QUAR) does not Granger Cause D(LCONST)	2	1.89204	0.1623
D(LCONST) does not Granger Cause D(LMIN_QUAR)		2.06861	0.1380
D(LWSALE_RESALE) does not Granger Cause D(LCONST)*	2	3.68173	0.0329
D(LCONST) does not Granger Cause D(LWSALE_RESALE)		1.68999	0.1958

- Note that * indicates rejection of the null hypothesis at 5 percent significance level.

The lag selection corresponds to reasonable beliefs, from both observation and the literature, about the longest time over which one of the variables could help predict the other and consistent with the optimal lag specification of the unrestricted VAR.

For the financial and insurance activities sector, the relation is bidirectional. The pull effect of the construction sector is significant for this sector. Furthermore, the financial and insurance activities sector plays a vital role in enhancing the activities of construction. In contrast, it is the wholesale and retail trade activities sector that has positive spillover effects on the construction sector, and not vice versa.

Vector error correction methodology

Once the long-run relationship is established, this means that there exists a corresponding error-correction representation that curtails any deviations from the long-run path of the variables under study. This error-correction representation expresses the changes in the dependent variable as a function of the level of disequilibrium in the cointegrating relationship and other explanatory variables. Moreover, an error correction representation of a disequilibrium relationship reduces possible problems of multicollinearity, since the correlation between Δx_{it} and $x_{i,t-1}$ is much smaller than that between x_i and $x_{i,t-1}$ (Thomas 1997). Accordingly, we need to estimate a vector error correction model (VECM) that will also identify the direction of the causality among these variables. Using the lag length specified in the unrestricted VAR, previously mentioned to be 2, the corresponding VECM is given by:

$$\Delta Y_t = \sum_{j=1}^{p} \Gamma_j \Delta Y_{t-j} + \Pi Y_{t-p} + \mu + \varepsilon_t \qquad (4)$$

where Δ is first difference operator and the expressions for Γ_j and Π are given in Johansen and Juselius (1990). The rank of the Π, r, equals the number of cointegrating vectors. The first term captures the short-run impact of the regressors, while the second term captures the long-run effects. Furthermore, Π can be factored as $\Pi = a\beta$, with the matrix β comprising the r cointegrating vectors and a can be interpreted as the matrix of corresponding VECM weights. These VECM weights a_i determine the short-run term error correction responses of the variables to deviations from long-run equilibrium values (Azhar, Khalil, and Ahmed 2007). The estimated results of the VECM are presented as follows:

$$\Delta const = 0.008 - 0.813 EC_{t-1} - 0.21 \Delta const_{t-1} + 0.37 \Delta const_{t-2} + 0.09 \Delta man_{t-1} + 0.14 \Delta man_{t-2} - 0.04 \Delta fin\_ins_{t-1}$$

(2.3) (-3.79) (-1.12) (2.92) (0.59) (0.96) (-0.28)

$$+0.003\Delta fin\_ins_{t-2} - 0.08\Delta \min\_quar_{t-1} + 0.55\Delta \min\_quar_{t-2} - 0.62\Delta wsale\_ret_{t-1} - 0.49\Delta wsale\_ret_{t-2}$$
$$(0.03) \qquad (-0.37) \qquad (2.97) \qquad (-3.77) \qquad (-3.15)$$

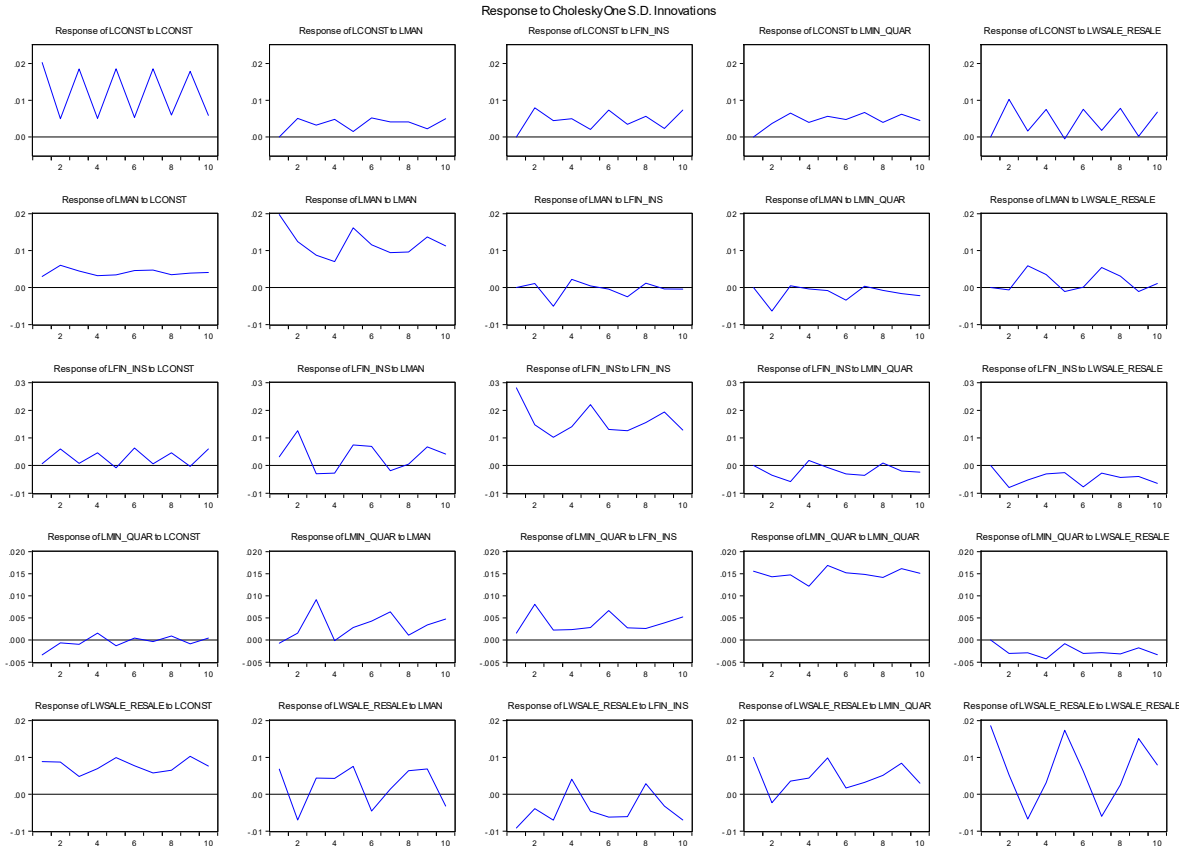
(5)

where EC_{t-1} is the lagged residual from the long-run relationship between the variables. This term represents the error-correction term. The coefficient of the error-correction term is statistically negatively significant, at 5 percent significance level. Thus, there is a tendency in the model to return to its long-run equilibrium path whenever it drifts away. That is, nearly 81 percent of the disequilibrium between the construction and the specified sectors output is compensated in the following quarter. This indicates quite a stable and mean reverting equilibrium between the sectors. In the short run, only the wholesale and retail trading output as well as the mining and quarrying one have significant effects on the construction sector output. The short-run causal effect of the wholesale and retail trade sector is attained at one quarter's time frame and persists to the second quarter. The mining and quarrying effect, on the other hand, is only attained after two quarters. The wholesale and retail trade sector is not conducive to the growth of the construction sector, in the short-run. However, the mining and quarrying sector is.

Finally, the short run dynamics of the model are analyzed through impulse response functions (IRF) and variance decomposition (VD). The IRF traces the response of an endogenous variable to a shock in that variable and in every other endogenous variable in the model. As for VD, it breaks down the variance of the forecast error for each variable into components that can be attributed to each of these endogenous variables (Pinkdyck and Rubinfeld 1998).

Figure 12 illustrates the responses of the sectors under study to each structural one standard deviation shock over two and a half years.

Figure 12. Impulse Responses of the Sectors' Output



Since our main focus is on the construction sector and its dynamic interrelationships with it top suppliers, we will explicitly consider the first row and first column of this output. The first row depicts the sensitivity of the construction sector output to changes in all the other variables. The first column, on the other hand, traces the effect of a one-period standard deviation shock of the construction output on each of the variables under study. A one-standard

deviation shock to the construction sector output has quite a persistent short-term effect on this sector. The wholesale and retail trade sector is the mostly affected sector, followed by the manufacturing and financial intermediation and insurance activities sector, both in the same direction of the construction sector shock. The mining and quarrying sector, in contrast, is slightly negatively affected in the first quarter. However, this effect dissipates quickly leaving no significant trace of this shock. Turning to the effect of shocks to the other sectors on the construction sector, it seems to be quite similar for the first three sectors. The effect is persistent in the same direction, however not much in magnitude. As for the wholesale and retail trade sector, the pattern is rather persistent and oscillating. This is similar to the pattern of the effect of the construction sector's own shock.

The forecast error variance decomposition of the construction sector output, as shown in Table 18, reveals quite a significant contribution of non-construction output shocks (reaching approximately 35 percent in 10 years horizon) in the overall movement of this sector's output in the short run. The wholesale and retail trading sector has the largest contribution, followed by the financial intermediation and insurance activities, then the mining and quarrying sector, and finally the manufacturing one. These results are quite consistent with the long-run analysis. This ordering, however, does not coincide with the relative shares of these sectors in the construction sector backward linkages, as indicated by the input output analysis.

Table 18. Forecast Error Variance Decomposition of Construction Sector Output

Horizon\Shocks	Const	Man	Fin_Ins	Min_Quar	Wsale_Ret
5 years	72.13910	3.901441	7.066100	6.519334	10.37403
10 years	65.58421	5.285050	9.231530	8.468740	11.43047

VI. ROLE OF CONSTRUCTION SECTOR IN ECONOMIC GROWTH

This section empirically investigates the relationship between construction sector developments and economic growth. It is worth noting that there is little evidence as to this presumed relationship in developing countries. However, for developed countries, most results confirmed the important role of the construction sector in economic growth.[9] They

[9] See Turin 1969; Wells 1986; Field and Ofori 1988; Bon and Pietroforte 1990; Bon 1992; Green 1997; Hillebrandt 2000; Lean 2001; Rameezdeen 2007; Dlamini 2011.

argued that construction creates job opportunities and generates income. Moreover, it has strong linkages with many economic activities and thus affects the growth process. As to the direction of this relationship, economists had different views in this regard. Some studies indicated the existence of a bi-directional causality between the construction sector and economic growth.[10] Others argued that it is a unidirectional one running from economic growth to the construction sector.[11] Accordingly, it would be beneficial to tackle this issue in the Egyptian context.

The quarterly data, previously specified, is employed for the log of construction output (LCONST) and log of GDP (LGPD). Table 19 presents summary statistics of the data. It is clear that both variables are normally distributed.

Table 19. Descriptive Statistics

	LGDP	LCONST
Mean	5.502361	4.079911
Median	5.524026	4.109844
Maximum	5.630331	4.323763
Minimum	5.361174	3.808806
Std. Dev.	0.080614	0.158872
Skewness	-0.298209	-0.144324
Kurtosis	1.650881	1.680686
Jarque-Bera	4.895636	4.103791
Probability	0.086482	0.128491

Table 20. Correlation Matrix

	LCONST	LGDP
LCONST	1	0.941
LGDP	0.941	1

The correlation matrix, as depicted in Table 20, reveals a strong positive correlation between the construction sector output and GDP. This goes along with the argument that construction sector developments and economic growth move together. However, the direction of the causality between the variables of interest cannot be yet decided. In order to employ the Granger causality test, variables must be stationary. The unit root tests for the variables indicate that they are both integrated of order one. They are made stationary by taking first differencing (Granger and Newbold 1986). The idea behind the Granger causality

[10] Bon, Birgonul, and Ozdogan (1999); Hongyu, Park, and Siqi (2002); Abdullah (2004); Khan (2008), and Jackman (2010).

[11] Wang and Zhou (2000), Hassan (2002), Tan (2002), Kim (2004), and Dlamini (2011).

test is to examine the direction of the relationship between pair wise variables in the model. The results of the test are shown in Table 21.

Table 21. Granger Causality between Construction Sector and GDP

Null Hypothesis	Lag Order#	F-statisitc	Prob.
D(LGDP) does not granger cause D(LCONST)	4	0.96119	0.4393
D(LCONST) does not granger cause D(LGDP)*	4	2.76662	0.0403

- Note that * indicates rejection of the null hypothesis at 5 percent significance level.

The lag selection corresponds to reasonable beliefs, from both observation and the literature, about the longest time over which one of the variables could help predict the other and consistent with the optimal lag specification of the unrestricted VAR.

It can be concluded that the relationship between the two variables is unidirectional. Construction activities induce economic growth. This sector leads GDP by one year. This could be attributed to the high multiplier effects this sector has through its extensive backward linkages. However, construction sector activities are not growth-driven. That is, it is not expected to follow the business cycle the economy is facing. This is considered quite an unexpected result. However, the fact that a considerable part of construction activities are done informally could be behind this counter-intuitive finding.

Again the Johansen's (1988) cointegration technique is employed to investigate the stable long-run relationship between the variables. The appropriate lag length was found to be 4 following Schwartz criterion. Statistical results of the Johansen test for cointegration are summarized in Table 22.

Table 22. Johansen Cointegration Test Results

Hypothesized No. of CE(s)	Maximum Eigen Value Statistic	Eigen Value	0.05 Critical Value

None*	17.96611	0.306952	14.26460
At most 1	1.854657	0.037143	3.841466

Notes: Cointegration test indicates 1 cointegrating equation (s) at the 0.05 level.
* denotes rejection of the hypothesis at the 0.05 level.

The maximum eigenvalue statistic as well as the trace statistic indicate that there is a unique equilibrium relation between construction output and GDP, in the long run, at 5 percent significance level. The estimated long-run relationship is given as follows:

$$LGDP = 3.51 + 0.49 LCONST \quad (6)$$

$$(36.25)$$

The number in parenthesis is the t-statistics. At 5 percent significance level, the construction output coefficient is significantly positive. This again confirms that the Egyptian construction sector significantly promotes economic growth. The corresponding VECM reports a significant coefficient of the error correction term equal to -0.78. This implies the existence of a stable long term causality running from construction activities to economic growth.

VII. CONCLUSION

The construction sector is considered a key sector in the Egyptian economy and a main contributor to economic development, specifically in total employment. However, its share in GDP is still modest when compared to other lower middle income countries. The sector is characterized by a high contribution of the private sector and large firms. This is despite the fact that the number of SMEs is large. The construction activities of the private sector are concentrated in Cairo and are mainly specialized in residential and petroleum construction. On the other side, public sector activities are dispersed across other governorates and not centered in Cairo. The public sector's main construction work targets infrastructure.

The supply chain of the construction sector is a converging and a make-to-order one. Informality and subcontracting are one of its main characteristics. However, subcontracting data are underestimated in the official figures. During the preconstruction phase, firms issue construction permits. In this matter, the number of procedures needs to be streamlined. Accordingly, a decline will be witnessed in the number of days required to issue a

construction permit. It is of equal importance to unify the implementation of the regulations across the governorates to make it easier for the private sector to operate outside Cairo.

The I/O table analysis was used to highlight the strong inter-sectoral linkages over a point in time. The construction sector is a key sector with high forward and backward linkages. The backward linkages are greater than one and evenly dispersed across the sectors, which indicate that the sector depends on other sectors in its inputs. The forward linkages indicator is not as high as the backward linkage, though greater than one as well. This indicates that the supply of the construction sector is mainly targeting new construction rather than repair and maintenance. In this aspect, the enforcement of the regulations needs to be stringent regarding the R&M activities to overcome the catastrophes of collapsing buildings that recur all over Egypt.

Furthermore, the study utilized econometric analysis to investigate the intersectoral linkages among the construction sector and its main suppliers, namely the manufacturing, financial and insurance activities, mining and quarrying, as well as wholesale and retail trade sectors over a period in time contrary to the input output analysis that highlighted the linkages over one point in time. In the long run, the financial intermediation and insurance activities sector as well as the wholesale and retail trading sector appeared to be positively associated with the construction sector. The pull effect of the construction sector proved to be significant for the financial and insurance activities sector. The growth of financial and insurance activities, in turn, enhanced the activities of construction through providing necessary liquidity. However, the wholesale and retail trade activities sector appeared to be conducive to the construction sector, and not the other way around. This long-run relationship proved to be quite stable and mean reverting. The VECM model indicated that nearly 81 percent of the disequilibrium between the construction and the specified sectors output is compensated in the following quarter. Accordingly, these two feeding sectors should be targeted by governmental policies to induce long-term growth of the construction sector. The growth of this sector is then expected to further enhance the financial and insurance activities.

In the short run, the wholesale and retail trading output, as well as the mining and quarrying one significantly affected the construction sector output. The mining and quarrying sector was found to be conducive to the growth of the construction sector unlike the wholesale

and retail trade sector. The former supplies important inputs of the construction sector. The latter, on the other hand, becomes influential only in the long run.

Shocks hitting the construction sector were found quite persistent in the short term. These shocks affected mostly the wholesale and retail trade sector followed by the manufacturing and financial intermediation and insurance activities sector in the same direction. This was unlike the mining and quarrying sector that slightly responded in the opposite direction of the shock during the first quarter. This effect quickly faded away over time. Regarding the effect of shocks hitting the construction sector feeding activities, they all resulted in a persistent, although limited, effect in the same direction of the shock. It was only the wholesale and retail trade sector shock that had a persistent and oscillating effect. As for the relative importance of the feeding industries in explaining movements in the construction activities, results indicated that wholesale and retail trading sector had the largest contribution, followed by financial intermediation and insurance activities, then mining and quarrying sector, and finally manufacturing. The inconsistency between this ordering and the one indicated by the input-output analysis could be attributed to the difference in the time frame of analysis. The former is concerned with short-term dynamics, while the latter is a static one.

The study also empirically investigated the relationship between construction sector developments and economic growth. A strong positive correlation between the construction sector output and GDP was reported. This relationship proved to be unidirectional, running from construction activities to economic growth. The construction sector proved to have high multiplier effects, stemming from its extensive backward linkages, which have positive impacts on macroeconomic performance. However, construction activities were found unaffected by the overall economic performance of the country. Even in times of recession, the construction sector could still be growing. This can be explained by the fact that this sector is mainly driven by government projects and growing population, regardless of the prevailing growth rates. Accordingly, the construction sector is expected to be a backbone of the domestic economy that not only promotes economic performance, but also has strong pull effects to a number of feeding industries.

Finally, the study can be extended by applying it to other sectors of the economy to identify their linkages. The results can be compared with other countries to mark the level of

development of the sector. However, differences across countries should be taken into consideration, including input price difference, construction technologies, and the product mix.[12] Besides, the study could cover sectoral interdependence using other measures of construction output, such as contracts awarded. Moreover, the impact on the employment level can be conducted using a similar econometric approach to investigate its multiplier effects on the economy.

[12] Polenske and Sivitanides (1990).

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