DETERMINANTS AND DYNAMICS OF SOCIAL AND WORKPLACE SEGREGATION: A SIMULATION STUDY

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Abstract

Segregation in workplaces and individuals' social networks based on ethnicity, race, and/or religion may have serious social and economic consequences. The relationship between social segregation and workplace segregation has been traditionally studied as a one-way causal relationship mediated by referral hiring. In this thesis, an alternative framework is introduced which describes the dynamic reciprocal relationships between social segregation, workplace segregation, individuals' homophily levels, and referral hiring.

An agent-based simulation model was developed based on this framework. The model describes the process of continuous change in composition of workplaces and social networks of agents (individuals), and how this process affects levels of workplace segregation and the segregation of social networks of the agents.

The simulation results indicated that a labour market may experience significant levels of workplace segregation and social segregation even when the hiring of workers occurs mainly through formal channels. The results also show that majority groups tend to be more homophilous than minority groups, that referral hiring may be beneficial for minority groups especially when the population is highly segregated, and that the relationship between referral hiring and minority unemployment is curvilinear. Levels of workplace and social segregation were found to be negatively correlated with minority proportion, average size of individuals' social network, and firm size, while they were positively correlated with overall unemployment level and hiring discrimination.

The research is based on primary data involving structured interviews with a sample of 39 employers and 122 workers (81 Muslim and 41 Coptic workers) in industrial firms in Egypt. Two secondary data sets were also used: the Social Contract Survey
(SCS) and *Workers' Status in Industrial Enterprises Survey (WSIES)*. The data were used to assess the levels of social and workplace segregation in Egypt (which found to be high), and to validate the simulation model.
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# Terms and Acronyms

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<td>Agent-Based Modelling</td>
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<td>ABSS</td>
<td>Agent-Based Social Simulation</td>
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<td>CAPMAS</td>
<td>Central Agency for Public Mobilization and Statistics</td>
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<td>ERFAIT</td>
<td>Economic Research Forum for Arab Countries, Iran and Turkey</td>
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<td>ERSAP</td>
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<td>ICS</td>
<td>Investment Climate Survey, 2004</td>
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<td>IDSC</td>
<td>Information and Decision Support Centre, Egyptian Cabinet</td>
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<td>MCSUI</td>
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<td>SCS</td>
<td>Social Contract Survey</td>
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<td>System Justification Theory</td>
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<td>SRC</td>
<td>Social Research Centre, the American University in Cairo</td>
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1 INTRODUCTION

1.1 Aims of This Chapter

The purposes of this introductory chapter are to: describe the research questions that animate the thesis and the answers which it provides, provide some background concerning the research context, present definitions of social and workplace segregation and provide evidence on the levels of these phenomena in Egypt, and finally give the reader an overview of how the thesis is organized.

1.2 The Origin of This Study

Egypt's Muslim and Coptic Christian communities have cohabitated peacefully for most of the last fourteen centuries. Yet, in recent years the clashes between the two communities have been increasing both in number and intensity. For example, Ibrahim (2006:19) estimated the number of sectarian clashes between Copts and Muslims to be more than 120 events in period between September 1972 to October 2005, that is, nearly 4 clashes per year.

These clashes often arise over everyday matters (for example, a dispute between farmers, or an argument between kids) but once sparked they often deteriorate into
large-scale conflicts. The authorities usually attempt to defuse these situations by holding a “customary session” in which the two parties are urged to reconcile.

In his attempt to answer the question: why are clashes between Muslims and Copts becoming a fixture of newspaper headlines, EI-Sayed (2007) denies what Egyptian officials always try to confirm, that Copts and Muslims live in an integrated society:

"The routine flash of cameras taking photographs of senior Muslim and Coptic clerics embracing one another on major religious occasions can no longer hide the less convivial reality, one in which attempts to build a church, the staging of a play about Muslim extremism by a Coptic youth group, the publication of improper photographs of a Coptic cleric, can all lead to violent clashes leaving tens of people injured and damage costing hundreds of thousands of pounds."

According to the Contact Hypothesis (Allport 1954, Amir 1969), more contact between different social (ethnic, racial or religious) groups would lead to more tolerance among members of these groups. So, these observed high levels of intolerance among Egyptians, both Copts and Muslims, may indicate that there is not “enough” contact between the two communities; in other words, Egyptians’ social networks became more segregated based on religion.

Based on this initial guess, that segregation in social networks (simply called “social segregation”) may be one of the reasons for the observed high level of intolerance, I have thought to measure this level of segregation, but unfortunately found no suitable

1 A “customary session” is an informal meeting usually attended by community leaders (for example, the governor, the representative parliament member, and religious leaders) in addition to the people involved in the dispute.
published data. However, some data were available from the Workers' Status in Industrial Enterprises Survey (WSIES) (2005) which could be used to measure the level of workplace segregation based on religion in a random sample of workplaces, and it was found to be very high (the Gini index of workplace segregation was 0.932). This high level of workplace segregation supported the assumption that there is limited contact between Copts and Muslims (at least) at work.

Based on the previous cursory investigation, a study to assess levels of social and workplace segregation in the Egyptian society, and to help understanding the emergence and dynamics of segregation (both in social networks and workplaces) would be useful (especially for decision makers) to control it and promote a more integrated society.

1.3 Research Overview

Workplace segregation based on ethnicity, race, and/or religion may have serious negative effects on a society. It has been documented that employed adults spend a large fraction of their time at work, and that a large fraction of non-family social interactions takes place at the workplace (Grossetti 2005). Thus, if workplaces become segregated based on ethnicity, race, or religion this would lead to less contact and less tolerance between different social groups; and, consequently, lower levels of social peace and social integration. In addition to these negative social effects, workplace segregation may have negative economic consequences. For example, it may introduce high levels of income and employment inequality between different groups in a society (Carrington & Troske 1998, Glass 1990, Tassier & Menczer 2005). Besides, workplace segregation may affect the whole economic system as it decreases the efficiency of allocating workers to jobs (Becker 1971).

While there is voluminous literature on the determinants and consequences of occupation and workplace segregation by sex (for a review, see Anker 1997), most
of the research on the ethnic segregation of workplace focused on the consequences (for example, income and employment inequality) rather than the determinants (Mittman 1992, Mouw 2002). Even for this little research on the determinants of the ethnic segregation of workplace, the underlying causal mechanisms between the determinants and the observed level of segregation have received little attention (some exceptions include Calvó-Armengol & Jackson 2007, 2004, Tassier (2005), and Tassier & Menczer (2005)).

According to the sociological literature, referral hiring (hiring employees through the use of social or familial contacts) is one of the most important determinants of workplace segregation. Using social networks and social contacts in matching jobs to job seekers is well-documented. For example, more than half of the workers in US find their jobs through friends, relatives, and other social contacts (Granovetter 1995, 1973). Montgomery (1991) summarizes this prevalence of referral hiring with the adage "It is not what you know but who you know" that matters.

Besides, the homophily hypothesis implies that people are more likely to create social ties with similar others, or "birds of a feather flock together" (Lazarsfeld & Merton 1954, McPherson et al. 2001). This similarity among network actors may be evaluated, among other factors, on the basis of race, religion and ethnicity. Thus when using social networks to search for jobs, it is more likely that people will have job information from others of the same ethnicity, race and/or religion as their own, and this may promote workplace segregation.

According to the previous analysis, researchers have studied the relationship between social segregation and workplace segregation as a one-way causal relationship. In this relationship, the independent variable is the level of social segregation and the dependent variable is the level of workplace segregation, with
the level of referral hiring as a moderating variable (Elliott 2001, Tassier 2005, Tassier & Menczer 2005).

In the current thesis, it is argued that the relationship between social segregation and workplaces segregation can also go in the other direction, that is, workplace segregation can affect (as well as be affected by) social segregation. Empirical literature confirms that a large proportion of social relations is embedded in organizations (Grossetti 2005). Organizations contribute to the construction of the pool of candidates with whom people might create social relations. Thus, when these pools become segregated social segregation is promoted and vice versa.

Based on this analysis, a general framework is introduced to study the dynamic and reciprocal relationships between social segregation, workplace segregation, homophily levels, and referral hiring within the Egyptian society. An agent-based simulation model for the Egyptian labour market has been developed based on this framework. The model creates an artificial society where agents (people) use their social networks to search for jobs. As simulated time passes, agents change their social networks by creating new social links (ties) with each other while other links dissolve. Also, the composition of workplaces (the proportion of workers from different social groups) may change through the turnover of workers.

The main objective of the model is to describe this process of continuous change in the composition of workplaces and social networks of agents, and how it affects the emergence and levels of segregation. The model is used as an experimental tool to investigate the potential effects of various factors on levels of segregation. These factors include: minority proportion, firms' sizes, social networks' sizes, overall unemployment rate, and hiring discrimination.

Three data sources have been used to build and validate the proposed model. One of these sources involved structured interviews with 39 Egyptian employers (owners or
mangers of small-to-medium industrial firms), and 122 workers (81 Muslim and 41 Coptic workers) in four Egyptian governorates. The other two sources are two national-level Egyptian surveys: Workers' Status in Industrial Enterprises Survey (WSIES 2005) and Social Contract Survey (SCS 2005).

1.4 Research Objectives

The direct objective of current research is to model the emergence of social and workplace segregation to get a better understanding of the dynamics that govern these phenomena. Within this general objective, specific research objectives include:

- Assessing the levels of workplace segregation, social segregation, hiring discrimination in Egypt.
- Investigating the effects of the following factors on the levels of social and workplace segregation:
  - Referral hiring
  - Overall unemployment rate
  - Sizes of social networks of agents (people)
  - Hiring discrimination
  - Minority group's proportion
  - Firms' sizes
- Investigating the relationship between segregation and employment inequality for majority and minority groups

1.5 Importance of the Research

The current research contributes to the theoretical understanding of the causal mechanisms of the relationship between segregation of social networks for religious
minority and majority groups and workplace segregation mediated by the use of referral hiring.

This research is the first to discuss the issue of segregation within the Egyptian society, and it is the first attempt to assess levels of segregation and hiring discrimination in Egypt. So, the research is novel in studying a minority-majority relationship in different context than the traditional settings. Being conducted in US or UK, most of the research on segregation (residential, occupation, or workplace) assumes two groups: a privileged majority (usually Whites) and an unprivileged minority (usually Blacks or immigrants). However, the Egyptian case provides a different context, where the minority, around 6 percent of the population, own more than 20 percent of the national wealth, and have generally better levels of education (Ibrahim 1996).

1.6 Research Context: Egypt in Brief

In the following, a brief background is given about Egypt: social, economic, historical, and ethnic and religious composition. This would clarify the context in which the research has been conducted.

1.6.1 Geography

The Arab Republic of Egypt is the centre of the Arab world, geographically and culturally, and it has a central position in the whole world as well. Egypt lies on the Mediterranean coast of North Africa, with Libya to the west, Sudan to the south and Gaza Strip, Israel, Jordan and the Red Sea to the East (see the map in Figure 1.1). The total area of Egypt covers approximately one million square kilometres; however, only 6 percent of this area is inhabited, the majority of the country is desert. Egypt's population was estimated in 2008 (excluding Egyptians abroad) at 76 millions (CAPMAS 2009), and it is concentrated in a narrow strip around the Nile River and
its Delta. The Nile, the main artery for Egypt, flows from Sudan in the south through Egypt into the Mediterranean at the Nile Delta near Alexandria, Egypt's second largest city after the capital, Cairo.

Administratively, Egypt is divided into 26\textsuperscript{2} governorates in addition to Luxor City. There are four Urban Governorates (Cairo, Alexandria, Port Said and Suez) that have

\textsuperscript{2} In April 2008, two new governorates were declared: Helwan and 6\textsuperscript{th} of October. Helwan included some parts of the administrative division of Cairo, and 6\textsuperscript{th} of October included some of Giza's. Since all data used within this thesis have been gathered before the creation of these two new governorates, the 26-governorate division will be assumed thereafter in this thesis.
no rural areas, while the other 22 governorates are subdivided into urban and rural areas. Nine of these governorates are located in the Nile Delta (Lower Egypt), and eight are located in the Nile Valley (Upper Egypt). The remaining five Frontier Governorates are located on the eastern and western boundaries of Egypt (CAPMAS 2009).

1.6.2 History

Egypt has been known as "The Cradle of Civilization", and its history goes back more than five thousand years. The Nile Valley has hosted imperial powers since the Pharaonic era. Then came the Persians, the Alexandrian Greeks (332 BC), and three centuries later the Romans took over in the year 31 BC. Christianity had been quickly spread in Egypt from the middle of the first century AD by St Mark the Evangelist. However, Copts broke from the rest of the Eastern Orthodox Church in the fifth century because of a theological difference over the essence of Christ. Copts suffered from the persecution of the Byzantium which reached its peak with the rule of Diocletian (284 AD) who was considered the most bloody and oppressive against Christians; that is why his era was known as the Age of Martyrs (303-11 AD) (Wakin 1963).

Struggle with Byzantium continued until the Muslim Arabs had conquered the country (640 AD). Roughly 200 years after the Arab conquest, Copts fell into the minority among their Muslim counterparts. From then until now, Coptic Christians have been a minority among Muslims. In 1517, Egypt became a part of the Ottoman Empire. During Ottoman times, Copts were quite spatially segregated from Muslims in Egypt because the empire organized its religious minorities into millets. Millets were highly autonomous areas set aside for Copts, Jews, Greek Orthodox, etc., each was controlled by a community’s religious leader. However, this spatial segregation faded greatly after Napoleon invaded Egypt in 1798, and finished the Ottoman rule.
The French rule was concluded by an Anglo-Ottoman alliance in 1801, and the Albanian Mohamed Ali came to power. His dynasty witnessed westernization of Egypt, the building of the Suez Canal, and colonization of northern Sudan. Mohamed Ali and his dynasty treated Copts with all due respect. He surrounded himself with Coptic aids, abolished all repressive laws against them, and suppressed any outbreaks of fanaticism. Generally, in the second half of the nineteenth century, the concept of equality between Muslims and non-Muslims had a great support. Exceptional taxes on Copts were cancelled and Copts were enlisted in the military service (Wakin 1963).

In 1882, a British force occupied Cairo, and the British Consul-General became the effective ruler. An Anglo-Egyptian treaty of alliance was signed in 1936, which recognized Egypt's full independence and introduced a phased withdrawal of British forces. Despite this, and the installation of an Egyptian royal family descending from Mohamed Ali's family, the British military presence and influence remained until 1956, when the final British troops left the Suez Canal zone. Coptic participation in the political life increased from the early twentieth century, two Copts became prime minister in the first two decade of the century. Coptic participation in the 1919 revolution has confirmed their role in the civil national state.

Recent Egyptian history originates with the revolution of 1952 by the Society of Free Officers (who did not include any Copts) in which the Egyptian king, Farouk, was overthrown and a republic was declared. Gamal Abdul Nasser became the president in 1954. After the 1952 revolution, the role of the Copts lessened in the community, and there was the first wave of Coptic migration. By the year 1977, the numbers of Coptic emigrants to Canada and US reached 85 thousands. Nasser died in 1970, without having recovered his popularity after the disastrous defeat of 1967 against Israel, and was succeeded by his deputy, Anwar Sadat. Sadat defeated Israel in
October war; after that, he brokered peace with Israel following his famous trip to Jerusalem in November 1977, when he addressed the Knesset.

Following the assassination of Sadat in 1981, his vice president Hosni Mubarak was appointed a president (a post he has been occupying till now).

In the recent decades, the relationship and interaction between Copts and Muslims have suffered from some disturbances because of the following:

- The rise of Islam militant groups in 1970s and 1980s which aimed to establish a political system based on Islamic rules ("shari'a" in Arabic). These groups created and mounted social tension and stress between Copts and Muslims, which lead to sectarian violence between them (Ibrahim 2006)
- The rise of Coptic groups since 1990s asking for equality and special treatment to compensate for periods of discrimination and persecution. For example, they have been asking for the abolition of the Hamayouni decree\(^3\), broadcasting their belief on the government TV and Radio stations, ending the discrimination in job appointments and promotions; teaching the Coptic history, language, and culture in schools and universities, and having a quota

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3 The Hamayouni Decree is based on an 1856 Ottoman law governing the construction of Christian places of worship. It was amplified as the Al-Ezabi Decree in 1934 as a set of ten conditions which have to be met before any application to construct places of worship can take place. Applications require personal approval from the President of Egypt. These requirements are not necessary for the construction of Muslim places of worship.
of the seats in the national parliament and regional assemblies. (Bebawi 2001)

- The rise of the immigrant Coptic groups in 1990s - in Europe, US, Canada, and Australia – who produced many studies and press releases to speak about the Copts' persecution in Egypt. Furthermore, they tried to transfer the Coptic issue to outside Egypt by inviting international society to protect Copts in Egypt (Brown 2000).

However, according to the Egyptian constitution, educational, employment and political rights are provided on a basis of equal opportunity.

1.6.3 Egypt's Ethnic and Religious Composition

Egypt is considered one of the most homogeneous countries with regard to its ethnic composition. The vast majority, 98 percent, of the population are Egyptian. The remaining minorities include: Berber, Nubian, Bedouin 1 percent, and Greek, Armenian, and other European (primarily Italian and French) 1 percent. The main religion of the Egyptian people is Islam, with 94 percent of the population being Sunni Muslims. The other main religious grouping is that of Coptic Christians, who make up most of the remaining 6 percent that are not Muslims.

Copts are concentrated more in the Upper Egypt where they constitute about 11 percent of the population, while they constitute only about 2 percent of the Lower Egypt's population. Within Cairo and Alexandria, Copts are concentrated in some

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4 The exact percentage of the Copts in Egypt is contested. The 1976 census records six percent of the total population, while some sources, based on Church statistics, estimate the percentage to be 18 percent (Al-Gawhary 1996).
districts (for example, Shoubra, Heliopolis, and Zeitoun in Cairo), but the general pattern in the cities is a spatial integration of Copts and Muslims (Purcell 1998).

Before the Arab conquest of Egypt in 640 AD, all Egyptians were known as Copts, and early Arabs called Egypt the Land of Copts. Actually, the word “Copt” is derived from the Greek word “Aigyptos” which means Egyptian (Wakin 1963). Copts follow three different denominations: the Orthodox, Protestant, and Catholic. However, the majority follow the Orthodox Church which is known as the Egyptian Church (Ibrahim 1996). As it will be used here, the term “Copts” is commonly used to refer to all Christians’ community in Egypt.

Copts are distinct in Egypt only on base of religion. They are not linguistically distinct, virtually all Copts speaks Arabic. However, there does remain most of the original Coptic language which has its roots in the languages of ancient Egypt. Some names are predominantly Coptic, such as Hanna, Girgis or Samuel, while others such as Mohamed or Ahmed are predominantly Muslim, but many can be both. Copts are not physically distinct from Muslims. Visual clues such as a crucifix or an icon of the virgin or a particular garment might identify a Copt as non-Muslim (Purcell 1998).

1.6.4 Economy and Labour Market

Egypt started an Economic Reform and Structural Adjustment Program (ERSAP) in 1991 to address its problematic social and economic situation which manifested itself in rising unemployment rates, increasing external debt, high inflation rates, and increasingly negative fiscal and external deficits. The budget deficit was reduced to a sustainable level, from 15 percent of GDP in 1991 to less than 1 percent in 1997 onward, and inflation dropped from 21 percent to 6 percent during the same period. However, the growth of the economy dropped by half from an annual average growth rate of 3 percent during 1987-1990 to an annual rate of 1.4 during 1991-1994, then increased again to the average of 4.3 percent during 2003-2008.
Estimates of unemployment and poverty in Egypt show a rising trend since the late
1980s. The unemployment rate was estimated, according to official figures, in 2008 to
be around 8.9 percent (5.9 percent for male and 18.6 for female) (CAPMAS 2009),
but it is believed to be higher (ERFAIT 2004).

Egyptian labour market can broadly be divided into public (government and public
enterprises) and private sectors. The public sector includes those activities owned by
and under the control of the state, for example, jobs in government agencies and
public sector enterprises. The public sector has been the most important source of
employment opportunities in Egypt, especially for graduates. In 1995, it constituted
the largest share of employment (62 percent). However, with the privatization of
public enterprises, the opportunities offered by this sector have been steadily
decreasing (Assaad 1997). The private sector involves activities that are owned and
directed by non-governmental economic units. In 1995, private wage work in Egypt
constituted 18 percent of the total wage employment.

The Egyptian labour market can also be divided into formal and non-formal sectors.
This distinction involves some procedures such as formal registration of firms and
their workers, social insurance for workers, etc. The contribution of the private formal
sector to total employment is relatively low. The informal sector has been growing
substantially during the past decade, absorbing the increasing numbers of new
entrants into the labour market, especially new graduates. This sector, which includes
small establishments (less than 10 employees) and employment outside
establishments, has shown increasing importance in livelihood opportunities since the
early 1980s. According to Assad (1997), it constitutes around 60 percent of the total
workforce in the private sector.

There are gender gaps in hiring and income levels in the Egyptian labour market.
Women are more than three times as likely to be unemployed than men. Those who
work earn significantly less than men, even after education and experience have been taken into account. The main reason for these gender gaps appears to be the slowdown in hiring in the government, a sector that treats women fairly equally to men. Besides, there is evidence of the high level of gender segregation in the labour market. Most employed women, outside the government, are relegated to a small number of industries and occupations. Women are disproportionately represented in textile and garment manufacturing, social services, and banking and insurance. On the other hand, females are concentrated in some professional occupations, such as teaching (40 percent), nursing (68 percent), and medical doctors (27 percent) (World Bank and the National Council for Women 2002).

1.7 Chapters in Brief

In addition to this introductory chapter, this thesis contains ten more chapters:

Chapter 2: Intergroup Relations: Theoretical Background

This chapter introduces the relevant literature about intergroup relations and the main theories that explain intergroup behaviour including Social Identity and Social Categorization Theories, Social Dominance Theory, and System Justification Theory. In addition, the chapter discusses how stereotyping, prejudice and discrimination can be reduced based on the Contact Hypothesis and affirmative action practices. Also, segregation is introduced as a complex and multi-dimensional concept that imposes restrictions on intergroup contact and how it relates to other concepts referring to these restrictions.

Chapter 3: Workplace Segregation

In this chapter, the concept of workplace segregation is discussed, and then different measures of workplaces segregation are introduced and evaluated. After that, a
review to the literature about the main factors affecting workplace segregation based on ethnicity, race, and religion is presented. The chapter ends with an assessment of workplace segregation by religion in Egypt based on data from Workers' Status in Industrial Enterprises Survey (WSIES).

Chapter 4: Social Networks and Social Segregation

This chapter presents a review of the literature about social networks, their importance as a job search method, and the consequences of using social networks as a job-search method on workplace segregation. The chapter starts by reviewing the recent history of social network analysis and the most famous network models including: Random Model, Small-World networks, and Scale-Free networks. Then, the chapter introduces some of the most famous theories of network formation and origins of social relations, and discusses the potential impact of social networks on individual's behaviour using Social Impact Theory.

Chapter 5: Agent-Based Social Simulation

The main objective of this chapter is to introduce agent-based social simulation (ABSS) as a research method. First, a brief history of the origin of social simulation is presented, then simulation is compared with other modelling approaches; for example, mathematical modelling. Chapter 5 also discusses the epistemologies of social simulation within the debate between rationalists and empiricists on how scientific knowledge could be gained. A justification for the use of simulation as a method for the current thesis is provided, and the chapter concludes with presenting the Schelling model as one of the most famous models of segregation.

Chapter 6: Methodology

This chapter includes a description of the main methods used to carry out the research. It provides a description of the sample design and survey instruments used
in data collection, the main problems found in the empirical study, and how these
problems were solved.

Chapter 7: Statistical Analysis of the Primary Data

The empirical results and statistical analysis for interviews with workers and
employers are presented in this chapter.

Chapter 8: Agent-based Simulation Model for Social and Workplace
Segregation

This chapter presents a simulation model for the relationship between workplace
segregation (based on race, ethnicity and/or religion) and segregation of the social
networks of individuals. The simulation model is based on the suggested framework
for the relationship between social segregation and workplace segregation. Some
experiments with the model are presented to test its validity qualitatively.

Chapter 9: Model Verification and Validation

This chapter discusses verification and validation of the simulation model that has
been developed in Chapter 8.

Chapter 10: Experimenting With the Model

Using the simulation model, this chapter presents some experiments that aim to study
the effects of factors such as unemployment level, size of social networks, hiring
discrimination, size of minority group, and firms’ sizes on social and workplace
segregation.
Chapter 11: Concluding Summary

The main research findings are summarized in this chapter, and directions for future research are discussed.
2 INTERGROUP RELATIONS: THEORETICAL BACKGROUND

2.1 Aims of This Chapter

The main purpose of this chapter is to briefly introduce, in Section 2.2, the literature about intergroup relations and the main theories explaining intergroup behaviour during intergroup contact: Social Identity and Social Categorization Theories, Social Dominance Theory, and System Justification Theory. Purely psychological theories, which consider prejudice as a personality disorder, are not considered relevant, so they will be skipped from the review. Then in Section 2.3, how stereotyping, prejudice and discrimination can be reduced based on the Contact Hypothesis and affirmative action practices is discussed. Finally, in Section 2.4, "segregation" is introduced as a complex and multi-dimension concept that imposes restrictions on intergroup contact.

2.2 Theories of Intergroup Relations

Creating and belonging to groups seems to be an intrinsic feature of mankind. People had been living in social groups since before the dawn of history. For a "group" to be constructed there should be clear criteria for membership which demarcate who is in and who is out of the group. Moreover, these criteria must be recognizable and valuable for the interacting individuals. Examples of these demarcation criteria are those referring to race, ethnicity, religion, gender, social class, physical proximity, etc. (Tajfel 1982b)
Intergroup relations refer to those interactions involving people from different social groups; as Sherif (1966:12) puts it:

"Whenever individuals belonging to one group interact, collectively or individually with another group or its members in terms of their group identification, we have an instance of intergroup behaviour."

Although intergroup relations, according to this definition, may refer to a wide range of interactions on many levels, the current thesis focuses only on individual-to-individual relations (specifically between Muslim and Coptic individuals in the Egyptian context).

Social groups usually differ in their social power and status which may introduce the risk of intergroup conflict. This conflict can be manifested in stereotyping, ingroup favouritism, prejudice, and/or discrimination that members of each group may practice against the outgroup members.

In the following, three of the most well known theories about intergroup relations are introduced to help understanding the motivational processes that explain people's responses to the members of outgroups.

2.2.1 Social Identity and Self-Categorization Theories

The "group identity" or "social identity" of individuals defines them as members of a particular social group, and differentiates them from the members of other different groups. Tajfel defines "social identity" as:

"that part of the individuals' self-concept which derives from their knowledge of their membership of a social group (or groups) together with the value and emotional significance of that membership" (Tajfel 1981:255)
The main premise of Social Identity Theory (SIT) (Tajfel 1982a, 1982b) is that social behaviour is a mixture of individuals' perception of themselves as individuals and as representatives of their ingroup. Thus, social behaviour usually falls somewhere on a continuum from interpersonal (when individuals' perception of their group membership does not play any role in their behaviour) to intergroup (when people's behaviour is fully determined by their group membership). The position of actual social behaviour on that personal-group continuum depends on the context of interaction. When group membership is salient, people will act as representatives of their groups rather than as individuals on the basis of their personal characteristics.

People tend to think of their ingroup as better than other groups, that is, to display ingroup favouritism. Ingroup favouritism is usually accompanied by negative stereotyping of outgroups and/or positive stereotyping of the ingroup. Stallybrass (1977:601) defines stereotyping as:

"an over-simplified mental image of (usually) some category of person, institution or event which shared, in essential features, by large numbers of people ... Stereotypes are commonly, but not necessarily, accompanied by prejudices, i.e. by a favourable or unfavourable predisposition toward any member of the category in question"

Self-esteem is one of the explanations of this ingroup favouritism suggested by Lemyre and Smith (1985) who found empirically that individuals' self-esteem is enhanced when they behave as group representatives.

While SIT hypothesizes that social behaviour is placed somewhere on the interpersonal-intergroup continuum, Social Categorization Theory (SCT) explains why and when a situation is considered interpersonal or intergroup by examining how people conceive of themselves (Tajfel 1981, Tajfel 1982a). According to the SCT, there is a tendency for individuals to categorize themselves in the group that will
provide association with a higher status. For example, in one setting, it may be more advantageous for someone to group himself/herself according to group identity (or characteristics) such as race or religion whereas in another setting, benefit may be derived from categorizing himself/herself based on personal characteristics such as educational experience. Group behaviour is possible when social identity rather than personal identity becomes salient.

2.2.2 Social Dominance Theory

While SIT and SCT focus on the individual-level factors that govern intergroup relations, Social Dominance Theory (SDT) pays great attention to the structural causes, and consequences, of group discrimination. The main concern of SDT is to explain how hierarchical social relations are formed and maintained (Sidanius et al. 2004). According to SDT, people tend to form and maintain group-based hierarchies, and all known forms of group-based oppression (for example: racism, ethnocentrism, classism, and sexism) are manifestations or special cases of this tendency. Sidanius et al. explain this in detail:

"Rather than merely asking why people stereotype, why people are prejudiced, why they discriminate, or why they believe the world is just and fair, social dominance theory asks why human societies tend to be organized as group-based hierarchies. By framing the question in this way, social dominance theory ... [is focused] on the universal and exquisitely subtle forms of discrimination and oppression that large numbers of people face in their everyday lives all over this planet." (Sidanius et al. 2004:846-847)

SDT proposes that human societies are stratified mainly along three qualitatively distinct systems of group-based hierarchies: age (elders have disproportionate power over youngsters), gender (men have disproportionate power over women), and an arbitrary set system not linked to the human life-cycle, which includes social groups
formed on the basis of, for example, race/ethnicity, class, or religion. Groups in these hierarchies differ in their social power and material resources (Pratto et al. 2006, Sidanius et al. 2004).

SDT suggests that group-based social hierarchy is produced and maintained by the net effects of discrimination across three levels: institutions, individuals, and groups (Pratto et al. 2006:275), and that this discrimination, to the favour of dominant groups over subordinate groups, is endorsed by using Legitimizing Myths (LMs) (Sidanius & Pratto 1999). LMs are ideologies, stereotypes, attitudes, or values that promote either the maintenance of group-based social inequality (hierarchy enhancing, HE-LMs) or greater levels of social equality (hierarchy attenuating, HA-LMs). Classic examples of HE-LMs are belief in a just world, racism and sexism. HA-LMs are illustrated by examples, such as universal human rights, feminism, and socialism.

On the Institution-level of discrimination, hierarchy-enhancing institutions (HEI) are those promoting inequality by disproportionately allocating more positive social value (or less negative social value) to dominant groups than to subordinate groups. In contrast, hierarchy-attenuating institutions (HAI) disproportionately support subordinate social groups (for example, ethnic and religious minorities).

Hiring discrimination, when an employer decides not to hire or promote a given job applicant due to his/her ethnicity, religion, or gender, is an example of individual-level discrimination. Social Dominance Orientation (SDO), a central construct in SDT, refers to and assesses individuals' desires for group-based dominance and inequality. For example, men, as a group, score higher in SDO than women as a group, and people belonging to dominant groups are, in general, higher in SDO than subordinates (Sidanius & Pratto 1999).

On the group-level, inequality can also be produced and maintained by intergroup processes between dominant and subordinate groups (Pratto et al. 2006). According
to Pratto et al., some of the mechanisms that play key roles in promoting groups hierarchy and inequality on that level include:

- **Asymmetrical Ingroup bias.** Members of dominant groups tend to show ingroup favouritism, more than subordinate groups do. This is called the "behavioural asymmetry hypothesis" (Sidanius & Pratto 1999:227), and it reinforces the dominance hierarchy since the behaviour of the subordinate group does not balance the effect of ingroup favouritism of the dominant group.

- **Asymmetry in Self-debilitation.** When members of subordinate groups engage in ingroup-damaging behaviour, crimes for example, that contributes to their own group's subordination, this negative effect is usually weaker when dominant groups engage in the same behaviour (Sidanius & Pratto 1999).

- **Ideological asymmetry.** Many of the factors that help promoting group dominance work better for people in dominant than in subordinate groups. For example, as mentioned earlier, SDO and people belonging to their groups are, in general, higher in dominant groups than subordinates (Sidanius & Pratto 1999).

2.2.3 **System Justification Theory**

A third theory of intergroup relations is System Justification Theory, SJT (Jost et al. 2004, Jost & Banaji 1994). SJT suggests that people are motivated to accept and perpetuate features of existing social arrangements, or status quo, even if those arrangements are not fair. In doing so, members of disadvantaged groups may support actions or beliefs that run contrary to their group's interests to maintain the current social system and group-dominance hierarchy. Zinn (1986:16-17) describes this tendency as follows:
“Society’s tendency is to maintain what has been. Rebellion is only an occasional reaction to suffering in human history; we have infinitely more instances of forbearance to exploitation, and submission to authority, than we have examples of revolt... What we should be most concerned about is not some natural tendency towards violent uprising, but rather the inclination of people, faced with an overwhelming environment, to submit to it.” (cited in Jost et al. 2004:888)

One of the social psychological mechanisms by which people legitimize and support the existing system is "sour grapes" and "sweet lemon" rationalization (McGuire & McGuire 1991). McGuire & McGuire postulate that people adjust their preferences to fit with their expectations about what is likely to occur. For example, they might support the existing system just because they expect that it is not possible to change it.

2.3 How Can Stereotyping, Prejudice, and Discrimination be Reduced?

In the following, two mechanisms are presented that can help to enhance intergroup relations and reduce stereotyping, prejudice, and discrimination: increasing intergroup contact and adopting affirmative action practices.

2.3.1 Contact Hypothesis

The Contact Hypothesis suggests that intergroup contact, particularly close and prolonged contact with members of different cultural or social groups, promotes the reduction of prejudice and more positive and tolerant attitudes toward members of outgroups (Allport 1954). The rational behind this positive effect is the idea that intergroup contact provides direct information and first-hand experience about other groups; for example, their values, behaviours and life-styles.
Significant attitude changes due to intergroup contact have been reported in much earlier empirical research across different contexts (for example, Ellison & Powers 1994, Emerson et al. 2002, Robinson 1980, Sigelman & Welch 1993, Williams 1964, Yancey 1999). For example Emerson et al. (2002) found that those who had experienced prior interracial contact in schools and neighbourhoods were more likely, as adults, to have more racially diverse general social groups and friendship circles.

However, it would be naïve to assume that any intergroup contact will produce the same (positive) results (Amir 1969). Mere contact is not enough to promote positive changes in attitudes and behaviour. Allport (1954) identified four key conditions that need to be satisfied before the desired effects of contact can be expected:

a. **Equal status of contact groups**: For contact to be successful (in reducing prejudice), it should take place between equal-status participants (Blanchard et al. 1975). Many prejudiced stereotypes of outgroups comprise beliefs about their inferior ability and performance. When the contact situation involves an unequal-status relationships with the outgroup person in the subordinate role, the existing stereotype are likely to be reinforced rather than hindered (Brown 1995). Relevant examples of previous empirical research, including Harding and Hogrefe (1952) and Minard (1952), showed that when Blacks and Whites worked together on equal-status base, the relationships between them were often harmonious.

b. **Acquaintance potential**: Contact should be of sufficient frequency, duration, and closeness. As Cook (1978:97) explains, it should be "high acquaintance potential". One would not expect that infrequent, short and/or causal contact would have a great impact on attitudes (Latané 1981).

c. **Pursuit of Common Objectives**: Cooperation to achieve common goals is a favourable condition for contact to reduce prejudice. Alport (1954:276)
stresses that "this type of contact that leads people to do things together is likely to result in changed attitudes". He continues, "in factories, neighbourhood, housing units, [and] schools, common participation and common interests are more effective than the bare fact of equal-status contact". Many empirical studies support this cooperation condition, especially when groups are successful in achieving their common goals (for example, Blanchard et al. 1975, Cook 1978).

d. **Social and Institutional support**: With explicit social sanctions and rewards, intergroup contact will have more positive effects. An authority, in the workplace for example (Morrison & Herlihy 1992), usually supports establishing norms of acceptance (Pettigrew 1998). An example is affirmative action, as discussed in the following.

### 2.3.2 Affirmative Action

Affirmative action refers to all voluntary and compulsory undertakings by governments and organizations to promote equal opportunity in employment and education for all people, regardless of social group (Crosby et al. 2003). By increasing the chance for different social groups to share the same workplace or educational institutions, affirmative action can be seen as a means of increasing intergroup contact and, thereby, promoting the reduction of group stereotyping, prejudice and discrimination.

One caveat that policy-makers should be aware of when applying affirmative action programmes is that affirmative action itself may promote discrimination instead of decreasing it; what is known as the reverse discrimination argument (Crosby et al. 2003:101). To promote, and monitor, equal opportunity, people have to be categorized into groups. This categorization process itself may promote stereotyping and prejudices.
2.4 Segregation as a Limitation on Intergroup Contact

There are many definitions of segregation, most of which share the same notion of segregation as a "restriction on the access of people to one another" (Freeman 1978:412), especially people from different social groups. For example, for van der Zanden (1972):

"Segregation may be thought of as a process or state whereby people are separated or set apart. As such it serves to place limits on social interaction." (p. 185)

Similarly, Berry (1958:273) defined segregation as a "form of isolation which places limits upon contact, communication, and social relations."

All previous definitions refer to physical restrictions on people accessing some physical space. This kind of segregation is called spatial segregation. Residential segregation, workplace segregation, and school segregation are all examples of this kind of spatial segregation. By limiting the physical access of people to each other, the chance of intergroup contact is reduced which may promote prejudice, stereotyping, and group discrimination.

However, as Freeman (1978) argues, what is more significant (because of its direct effect on intergroup contact) for intergroup relations is the limitation on interaction rather than limitation on access. Limitations on interaction represent what can be called "segregation in social space" (Freeman 1978:413), and it refers to segregation in the social networks of people, what is referred to here as social segregation. People may have access to each other, they may live in the same neighbourhood, go to the same schools; yet, their interaction may be still limited. For example, live-in servants may share the same physical space with their employers; yet, their interaction is limited, and their social space is segregated.
2.5 Segregation as a Complex Concept

Segregation is a complex concept in the sense that it has many dimensions and intertwines with many other concepts. Massey and Denton (1988) mention five dimensions of segregation: evenness, exposure, concentration, centralization, and clustering. Although these dimensions of segregation are distinctive, they are highly correlated. For example, if there is a high level of unevenness we expect a high level of exposure and clustering. Usually, the term "segregation" is used to refer to one or more of these dimensions.

2.5.1 Evenness

The term "Evenness" refers to the extent that all social groups are proportionally presented in the spatial units of interest (for example, workplaces, residential areas, and schools) (Duncan & Duncan 1955). A minority group is said to be segregated if it is overrepresented in some units while underrepresented in others. Evenness is the dimension of the focus for the current thesis because it is the most commonly-used dimension of segregation (for example, most of segregation indices capture this dimension of segregation), besides it can be used to refer to both spatial and social segregation.

Egyptian Copts are not evenly distributed among the Egyptian governorates. They are overrepresented in some governorates in Upper Egypt, such as Assuit, more than Lower Egypt. Moreover, they are not evenly distributed inside governorates; they are more concentrated in urban areas and big cities rather than villages (Ibrahim 1996).

1 When the term "segregation" is used without any preceding adjective, it will refer to spatial segregation.
2.5.2 Exposure

According to Massey and Denton (1988):

"Residential exposure refers to the degree of potential contact, or the possibility of interaction, between minority and majority group members within geographic areas of a city." (p. 287)

The "degree of potential contact", in Massey and Denton's definition, refers to the probability of the two groups, majority and minority, to live in the same geographic area. For example, if a member of a minority group is picked at random, a measure of exposure should refer to the probability for this person to share the same neighbourhood with one of the majority group members. In this sense, all exposure indices are asymmetric and dependent on the minority proportion\(^2\). That is, the exposure of the minority to the majority is bigger than exposure of the majority to the minority. Since they represent a relatively small proportion of population, around 6 percent, Copts have a high exposure to Muslims while Muslims have a lower exposure to Copts.

2.5.3 Concentration

Concentration is the third dimension of segregation, and it refers to "the relative amount of physical space occupied by a minority group in the urban environment" (Massey & Denton 1988:289). For example, if we have two cities A and B, each with the same minority proportion and the same level of evenness (that is the minority

\(^2\) Hence, most of exposure indices are compositionally invariant, and cannot be used for comparison among different cities or countries (for more details see Section 3.5.7 of the next chapter).
group members are evenly distributed among residential areas inside each city), but most of the minority of city A living in lesser number and/or smaller areas than the minority of city B, then the minority concentration of city A is more than that of city B; hence, A is more segregated than B.

2.5.4 Centralization

The fourth dimension of segregation is Centralization, which is "the degree to which a group is spatially located near the centre of an urban area" (Massey & Denton 1988:291). Living near city centres may provide more access to some resources (for example, schools, jobs, transportation, and safety) than living in suburban or peripheral areas. Hence, preventing minority groups from living in these locations is considered a source of discrimination, and is considered a dimension of segregation.

Copts show high level of centralization. They tend to be concentrated in urban areas and city centres more than rural and peripheral areas. The main reason is that urban areas, where police stations are easily accessible and anonymity is greater, are usually safer for Copts than other areas (Ibrahim 1996).

2.5.5 Clustering

Clustering is the last dimension of segregation suggested by Massey and Denton, and it refers to:

"the degree of spatial clustering exhibited by a minority group, that is, the extent to which areal units inhabited by minority members adjoin one another, or cluster, in space" (Massey & Denton 1988:293).

A high degree of clustering would result in a residential pattern where minority areas are contiguous creating some sort of ethnic or racial enclaves similar to that presented in the famous Schilling model (Schelling 1971).
2.6 Chapter Conclusion

In this chapter, a brief introduction to the main theories of intergroup relations was presented. This covered Social identity and Social Categorization Theories, Social Dominance Theory, and System Justification Theory. The Contact Hypothesis and affirmative action were introduced as factors that increase the chance for intergroup contact. It was concluded that for a contact to be successful in reducing prejudice, stereotyping and group discrimination some favourable conditions have to be satisfied. These favourable conditions include: (a) equal status of contacting groups, (b) contact should be acquaintance potential, (c) groups should pursue common objectives, and (d) there should be social and institutional support.

On the other hand, segregation was introduced as a barrier against intergroup contact. Segregation was discussed as a complex and multi-dimensional concept that subsumes other concepts such as evenness, exposure, concentration, centralization, and clustering.
3 WORKPLACE SEGREGATION

3.1 Aims of This Chapter

In the previous chapter, the concept of "segregation" has been introduced as a limitation on the intergroup contact. In the current chapter, the main focus is on a special kind of segregation: workplace segregation (while social segregation will be discussed in Chapter 4). The main objectives of this chapter are to introduce the concept of workplace segregation, and to review the main theories that explain why workplaces become segregated based on gender, race, ethnicity, and/or religion. In Section 3.2, the concept of "Workplace Segregation" is defined, and then a review is presented of the main factors affecting the demographic composition of workplaces in Section 3.3. The consequences of workplace segregation for workers, social groups, and firms are discussed in Section 3.4. Section 3.5 presents some popular measures of segregation and a comparison of these measures. Finally, Section 3.6 provides an assessment of workplace segregation (based on religion) and hiring discrimination in Egypt based on data from Workers' Status in Industrial Enterprises Survey (WSIES 2005).

3.2 The Concept of Workplace Segregation

According to Mittman (1992:7), "organizational demography consists of the patterns or distributions of demographic traits within and across organizations and their subunits". Workplace segregation refers to the relative demographic composition of organizations to that of entire labour market. Workplaces are said to be segregated
based on some attribute or trait (for example, ethnicity, race, religion, gender, age, and education) if the distribution of employees according to this factor or trait in these workplaces is different from their distribution in the labour force. The larger the difference between the two distributions the larger is the segregation level.

Beside the firm level, researchers have addressed the topic of ethnic and gender segregation at the levels of occupation and industry (see for example, Blackburn & Jarman 2006, Carlson 1992, Fossett et al. 1986, Glass 1990, Olzak 1989). But both occupations and industries are abstract levels rather than a tangible environment in which people work, "... occupations and industries do not employ workers or constitute settings in which people work" (Reskin et al. 1999 :336). Firms are also actors in employment decisions. Hence, it is important to study segregation and the stratification of the labour market on the firm level. That is why Baron and Bielby urged the researchers of labour market stratification to "bring firm back in" since "firms link the 'macro' and 'micro' dimensions of work organization and inequality" (Baron & Bielby 1980 :738).

The current thesis focuses on one aspect of demographic composition of organizations: the religious affiliation of workers. The research is relevant to the literature on ethnic and racial segregation of the workplace. Although religious affiliation, ethnicity, and race are conceptually different, they have the same effect of dividing the population into distinctive, usually competing, groups.

3.3 Factors Affecting Demographic Composition of Workplaces

Factors that affect the demographic composition of workplaces can be broadly categorized into pre-hire and post-hire factors (Sørensen 2004). The pre-hire category includes factors affecting the hiring process, that is, the process of matching jobs to job seekers. These factors can be further divided into: demand side factors (pertaining to the demand of labour, that is, employers and firms), supply side factors
(pertaining to the supply of labour, that is, employees), and the information flow about vacant jobs and prospective employees that matches the two sides\(^1\).

The post-hire category includes factors that affect the employees' turnover and their attachment to their firms. In the following, a brief review is presented of the literature about each of these two categories of factors, and how they affect the demographic composition and segregation of workplaces. Firstly, different modes of job matching are introduced.

### 3.3.1 Modes of Job Matching

Two major modes of job matching can be identified within the literature of labour market: informal matches (which can be further subdivided into non-search matches and active search through personal intermediaries) and formal matching (Elliott 2000, Granovetter 1995).

In non-search matches, the employment occurs without an active search on the part of the employee. Direct job offering from an employer of a firm to a prospective employee is an example of this kind of recruitment. This type of job matching is mainly used for recruiting professional, technical, and managerial employees (which Granovetter (1995) called PTM jobs). In Granovetter's study of PTM jobs in Newton, Massachusetts, about 30 percent of the sample did not actively search for their jobs.

Active search through personal intermediaries, that is, referral hiring, represents another type of informal matching. Using social ties is beneficial for both job seeker

\(^1\) The information flow and use of social networks in job search will be discussed in more detail in the next chapter.
and employers. For a job seeker, using social ties increases the probability to find a job (Battu et al. 2004, Elliott 2001, Green et al. 1999, Tassier & Menczer 2005), and it is less costly in terms of time and money than any other method (Holzer 1988). Employers also regard the friends and relatives of their employees as a reliable source of information. Besides, using social ties reduces the cost of hiring; for example, screening process, advertising costs, and interviewing (Fernandez et al. 2000, Holzer 1988, Montgomery 1991, Rees 1966).

In formal job matching, a job seeker uses formal or “open” recruitment channels; for example, answering a classified advertisement, sending a résumé, or using an organizational liaison such as a school placement office or a state employment agency. This type of job matching involves an active and relatively open search on the part of both employers and employees (Elliott 2000).

3.3.2 Differentials in Job-Search Strategies

Although crucial for obtaining jobs, social contacts are not equally important for everyone. Empirical research reveals variations in the extent and outcome of using social contacts as a job-search method. There are variations by race/ethnicity, class position, gender, age and level of education.

3.3.2.1 By Race/Ethnicity

Racial and ethnic groups vary in their job-search strategies. Moreover, the outcomes of these job-search strategies may vary for racial and ethnic groups (Battu et al. 2004, Green et al. 1999) and for different classes of labour (Elliott 2000, Granovetter 1995).

Green and colleagues (1999) examined job-search strategies among individuals from four ethnic and racial groups: White, Black, Hispanic, and Asian. They analyzed the
specific effects on earnings of using informal versus formal job-search strategies, strong versus weak ties among job contacts, and multiplex versus one-dimensional social ties among job contacts. Their results showed that Hispanics rely on informal search strategies much more than other race and ethnic groups do, and the use of these informal strategies leads to lower-paying jobs. They also found that using multiplex ties (that is, a person who is a friend or relative, a co-worker, and a neighbour) leads to lower-paying jobs for Blacks and higher-paying jobs for Whites.

Battu and colleagues, in a similar study, examined the job finding methods of different ethnic groups in the UK. They found important differences in using social networks as a job search method across ethnic groups, and in the outcomes of this method. Their results show that Pakistani and Bangladeshi groups and those born outside the UK (recent immigrants) lose out disproportionately from using personal networks (Battu et al. 2004).

3.3.2.2 By Class of Labour

Job-search strategies and outcomes may also differ for different classes of labour. Elliott (2000, 2001) and Granovetter (1995) show that nonsearch matches play a more vital role in filling managerial positions than skilled and general labour positions. The rationale is that the loyalty and trust required in this class of labour increase organization incentives to search for employees. Besides, managerial positions are relatively few in number, so matching can often be more direct. Skilled labour, on the other hand, flows more readily through formal channels supported by educational credentials, with formal channels also serving to increase the geographic scope of prospective searches and hires. In contrast, general labour which possesses neither organizational authority (such as managers) nor socially recognized expertise (such as skilled labour) favour informal matches that bring active searchers to employers (Granovetter 1995).
3.3.2.3 **By Education**

Many empirical studies show that relying on social contacts for attaining a job is more important among less-educated workers than highly-educated ones (for example, Battu et al. 2004, Santamaria-Garcia 2003, 2004). However, the reasons for this result are not quite clear. Battu et al. (2004) found that the highly educated are more likely to offer themselves directly to potential employers and are more likely to respond to advertisements. "The highly educated are in a sense more pro-active in selling themselves to potential employers via more mainstream methods" (p. 16).

For Santamaria-Garcia (2003, 2004), the lower cost of using social contacts is the driving force behind the reliance on such a channel. Workers with a low level of education are expected to be hired in homogeneous jobs and to be paid less. Thus, they find social contacts, as a cheaper alternative to formal search, more attractive. On the other hand, those with high levels of education prefer to pay higher formal-search cost in order to find the right job.

3.3.2.4 **By Employment Status**

While unemployed individuals search for jobs, employed ones may also search for better jobs. Holzer (1987) argued that the higher costs of search for unemployed than for employed job seekers may make the former spend more effort in the search and to have lower reservation wages. He provided empirical evidence that young male job searchers use more search methods and spend more time per method than employed ones.

3.3.3 **Demand-Side Factors**

On the side of employers and firms, the following factors may affect the demographic composition of workplaces.
3.3.3.1 **Hiring Discrimination**

Hiring discrimination implies that employers may be reluctant to hire workers of a certain sex or race just because they feel uncomfortable with or hostile to persons from these social groups. In his seminal work *The Economics of Discrimination*, Becker (1971) quantifies this "taste for discrimination" by the Discrimination Coefficient, DC. DC indicates the "extra cost that an employer feels he/she pays when hiring a worker from a group he/she dislikes" (Becker 1971:14).

According to Becker's theory, which is based on the assumptions of a competitive labour market, employers who express discrimination will pay extra cost to avoid hiring workers from the groups they dislike and to hire from different groups. By doing so, they will be eventually excluded from the market because they will be less efficient than other more egalitarian employers who do not pay this extra cost. However, this theory is controversial, especially in situations with high levels of unemployment, which make it easier for employers to discriminate without paying such extra costs.

Empirically, hiring discrimination has been considered the main factor affecting the demographic composition of workplaces. For example, Carrington and Troske (1998:250) show that firms whose owners and/or managers are black are more likely to hire more Black workers, and that is assumed to be due to hiring discrimination. Similarly, the WSIES data provide strong evidence of widespread hiring discrimination among Egyptian employers.

The relationship between hiring discrimination and workplace segregation is both theoretically and empirically established. Becker argued that "the trade [of labour and capital] between two societies is maximized when there is no discrimination, and it decreases with all increases in the discrimination" (1971:22). Becker shows that the
minority group is hurt more than the majority as a result of discrimination even if it decided to retaliate and discriminate against the majority group.

However, Carrington and Troske (1998) found that the relationship between hiring discrimination and workplace segregation is mediated by the proportion of Blacks who are employers. So, although a strong relationship exists between the race of employers and that of workers, only a low level of segregation was found, mainly because "there are not many Black employers" (1998:232).

3.3.3.2 Statistical Discrimination

Statistical discrimination implies that firms use race or sex as a proxy for productivity, skills, or employment costs (Reskin et al. 1999:339). Statistical discrimination differs from hiring discrimination in that the former is built upon a belief (which may be false) that some groups (Whites or Men) are better (for example more productive) to hire than others. So, while hiring discrimination is based on employer's "taste" (Becker 1971), statistical discrimination is based on a rational decision to hire the most productive workers.

Statistical discrimination may act as a self-fulfilling prophecy, illustrated by Merton (1968:477): "In the beginning, a false definition of the situation evoking a new behaviour which makes the original false conception come true". According to the statistical discrimination model of Arrow (1972), which explicitly models labour market outcomes as a rational expectations equilibrium, employers' beliefs about workers' skill levels determine their willingness to hire, which in turn determines the rate of return on human capital investment, which determines workers' actual skill levels.

Blume (2006) introduced a model for statistical discrimination to highlight the role of learning in belief formation and in driving equilibrium selection. According to Blume's model, there is an outgroup which is the potential victim of statistical discrimination.
Firms have beliefs about the productivity of this outgroup, and these beliefs are revised for each new cohort based upon firms' collective experience with the previous cohort. On the other hand, workers must make a decision about investing in skills before entering the market, and in making this decision they rely upon their beliefs about labour market outcomes, which also arise from learning. Empirically, Mittman (1992) shows that the more establishments practice statistical discrimination, the more women and minorities will be underrepresented, and the higher the level of segregation will be.

3.3.3.3 Hiring Practices

The demographic composition of firms is strongly affected by their hiring practices. Formalized practices and the existence of formal organizational structures such as human resources departments usually increase the opportunities for women and minority groups (Baron & Bielby 1980). On the other hand, recruiting through informal channels, such as referral hiring, reproduces an establishment's composition because workers tend to pass job information to people similar to them (Elliott 2001, Fernandez et al. 2000).

Elliott (2001) provides a systematic examination of the role of insider referrals in matching workers to jobs, emphasizing the contribution this process makes to the reproduction of ethnic segregation in local labour markets. As Elliott explains:

“... [Referral hiring] creates a built-in bias toward incumbents: members of a particular ethnic group concentrate in particular jobs and when new employment opportunities become available at their workplace, they pass this information along to social contacts, often of the same race and ethnic background” (Elliott 2001:401).

The results of Elliott's work showed that insider referrals account for a third of all new hires in Atlanta, Boston, and Los Angeles during the early 1990s with some variation.
by different ethnic groups. Latinos are more likely than other ethnic groups to gain
employment through insider referrals. Also, Elliott shows that native-born Blacks who
acquire jobs through insider referrals are significantly more likely than other types of
workers to enter, and thus help to sustain, ethnically homogeneous jobs (Elliott 2001).

Mouw (2002) estimated that about 10 percent of the observed workplace segregation
of the blue-collar employees in the Multi-City Survey of Urban Inequality (MCSUI)
data can be attributed to a combination of informal hiring practices and racial
referral hiring contributed to the overrepresentation of Asians in firms, relative to both
the pool of people who could be expected to apply for the jobs and the pool of actual
applicants.

Employers might also favour job referrals when hiring new employees. Referral hiring
allows employers to use employees' social ties for their own advantage (Fernandez et
al. 2000, Montgomery 1991). Insider referrals make the pool of job applicants richer
since they usually enhance the number and the quality of applicants. Besides, an
insider referrer is likely to help the newcomer in the organizational socialization
process and perhaps even with job training, thereby boosting productivity and
enriching the nascent bond between the employer and the new worker (Bacharach et
al. 2005).

3.3.3.4 Market-Based Incentives

An organization's clients sometimes create a biased demand towards some
ethnic/gender groups. For example, the proportion of Black workers was found to be
correlated with the number of Black customers of organizations (Carrington & Troske
3.3.3.5 Firm size

Many scholars document a strong relationship between an establishment's size (in terms of number of employees) and the hiring of racial and ethnic minorities. For example, Holzer (1998) tried to answer the question: why do small establishments hire fewer Blacks than large ones? He concluded that discrimination in hiring may be much more pervasive at smaller establishments than larger ones. The main reason behind this, according to Holzer, is that smaller firms are less likely to have formal human resources departments than larger firms, so they rely heavily on less costly informal recruitment channels and subjective hiring procedures such as interviews. These informal recruitment methods create greater disadvantages for Blacks.

3.3.4 Supply-Side Factors

The following factors may affect the structure of the supply of labour.

3.3.4.1 Composition of the Labour Pools

The composition of the labour pool from which firms hire their workers is an important determinant of their demographic composition. If firms hire workers based on objective bases (skill level for example) regardless their sex or race, it would be expected that the sex and race composition of these firms is roughly proportional to that of the supply of qualified workers in the labour pool (Reskin et al. 1999). Carrington and Troske (1994) found that, among small-to-medium firms, the more female-intensive the industry, the greater women's share of the jobs in these firms. Similarly, Reskin et al. (1999) found a positive correlation \( r=0.71 \) between women's share of full-time jobs in a national sample of establishments and their share of jobs in their establishments' industry.
Two important factors may affect the composition of the labour pool for a firm: firstly, the types of skills required by the firm and the distribution of these skill by sex and race; and, secondly, the composition of the local labour market. The distribution of individuals across occupations and workplaces is partly determined the underlying demographic distribution of human capital and skills (Sørensen 2004). Factors causing these differences (in human capital and skill) across social groups include segregation in the educational system which leads to higher sex/racial segregation in jobs with greater general skill and training requirements (Farkas & Vicknair 1996).

The composition of the local labour pool may lead to segregation in workplaces through the role of residential segregation and its implications for the matching of workers to jobs (Holzer 1991, Mouw 2002). If employers rely on local labour pools, workplaces will reflect this uneven racial distribution. For example, Mouw (2002) estimated that approximately 10 percent of the observed workplace segregation of blue-collar workers in the MCSUI data was caused by residential segregation. Also, Holzer (1991, 1996) found that firms' proximity to African Americans affects the likelihood of Blacks to apply and to acquire jobs in these firms.

Thus, when measuring segregation at the level of the workplace it is a good idea to control for the effects of occupational and residential segregation. A firm's tendency to hire more Blacks may be due to the fact that more Blacks live around this firm, or because the proportion of Black in the industry or the activity of this firm is high.

3.3.4.2 Relative Numbers, Group Power, and Threat

The demographic composition of labour market influences a firm's composition because it may affect the balance of power between different groups (Reskin et al. 1999). In general, the more attractive an organization, in terms of wages, benefits, and promotion opportunities, the greater the current workers' tendency to exclude outsiders especially from ethnic and minority groups (Carrington & Troske 1998).
3.3.4.3 **Labour Costs and Group Status**

Employment costs may vary for equally productive workers who differ in race or sex. For example, White male labour usually costs more than hiring women or nonwhite male workers. So, firms that can afford hiring White males are likely to hire them because this may imply a higher status for the employers (Reskin et al. 1999). In his audit study of sex discrimination in hiring in a sample of restaurants in Philadelphia, Neumark (1996:928-931) found that in high-price restaurants, job applications from women had an estimated probability of receiving a job offer that was lower by about 0.4 (even after controlling for human capital and skill level), and an estimated probability of receiving an interview that was lower by about 0.35.

3.3.5 **Post-Hire Factors**

Most labour market research has focused on the pre-hire factors, that is, those factors affecting the probability of a job seeker to get a job and enter a firm (for example, job search and recruitment processes). However, exit factors, factors that may cause worker to leave the firm, should have similar attention. As Sørensen (2004) explains, a firm may recruit its employees based on equal opportunity practices, and may start with all social groups proportionately represented in it, and yet segregation may occur due to the exit patterns of employees and their responses to changes of the racial composition of their workplaces.

Sørensen (2004) studied how workers respond to changes in the racial composition of their workplaces. The results indicated that workplace's racial composition significantly affects employees' turnover. Exit rates were found to be inversely related to the level of same-race representation at the time of organizational entry and increases when workers experience declines in same-race representation. However, Sørensen found that turnover rates do not decline in response to increases in
representation of same-race. This indicates that initial status can have a lasting impact on the attachment of employees to their firms.

3.4 Consequences of Workplace Segregation

A firm's sex and race composition is an important structural property that would affect employees' social behaviour. Pfeffer stressed this importance:

"[T]he relative proportions of [groups] condition the form and nature of social interaction and group processes that in turn affect workers' psychological well-being, attitudes, and even job performance." (Pfeffer 1983:303-304)

An establishment's sex and race composition could have consequential effects on the worker, group, and firm levels (Reskin et al. 1999).

3.4.1 Effects on Workers

3.4.1.1 Performance Pressure:

Workers from minority groups may feel highly visible to others in their workplaces, and this visibility may increase their feeling of performance pressure. According to Kanter's (1977:210-214) theory of proportional representation, individuals who hold minority positions experience greater symptoms of psychological distress and anxiety compared to others working in settings dominated by members of the same gender or race. The source for this stress, according to Kanter, is partly that minority group members, or "tokens" in Kanter's terms, feel that they are symbolic representatives of their "type". This feeling adds more pressure on them to perform well as this may be consequential to other individuals of their social group.

Empirically, in a sample of Black leaders in the US, Jackson et al. (1995:550-551) found that Black leaders who were outnumbered by Whites in their workplaces...
suffered higher levels of stress than those who worked in balanced situations or situations where Blacks outnumbered Whites. They also found that men and women who were outnumbered in their work settings by the opposite sex exhibited higher scores of distress and anxiety than those who were surrounded by equal or greater number of the same sex.

3.4.1.2 Job Satisfaction and Turnover

Empirical research on work groups supports the hypothesis that negative reactions of majority group members to minorities are correlated with the proportion of the minority. For example, Wharton and Bird (1996:110) found that men in predominantly male and mixed-sex work groups were more satisfied than men in all-male groups. Moreover, both male and female workers in gender-balanced groups expressed more satisfaction than workers in homogenous groups. Regarding workers' turnover, as explained earlier, Sorensen (2004) showed that the racial composition of a workplace affects employees' turnover. He found that exit rates are inversely related to the level of same-race representation at the time of organizational entry and increase when workers experience declines in same-race representation.

3.4.2 Effects on Groups

Empirical research emphasises the importance of workplace sex and race composition on the probability of intergroup contact and group cohesion (for example, Jacobs 1986, South et al. 1983). In a sample of 76 workgroups in a public agency, South et al. (1983:594-596) found that having a higher proportion of female group members leads to less frequent contact between females and male group members and to less social support from those members. Furthermore, South et al. showed that the female proportion in a workgroup is negatively correlated with the amount of encouragement for promotion they receive from their male supervisors.
Empirical results concerning the effect of the demographic composition of workplace and the outcome of the intergroup contact and group cohesion seem controversial. Interpersonal attraction and trust hypothetically increase with workgroup homogeneity (Lazarsfeld & Merton 1954, McPherson et al. 2001). Although South et al (1983) support this hypothesis (as they found a negative correlation between female proportion and the social support they receive from male colleagues), Wharton and Bird (1996:109) do not. They found a positive correlation between the percentage of women in university departments and workers' perception of cohesion, where men in all-male departments expressed the least cohesion and men in predominately female departments expressed the most.

3.4.3 Effects on Firms

The effect of the organization's composition on its performance seems to be contradictory at both theoretical and empirical levels (although most empirical research indicates that the relationship is curvilinear). On the theoretical level, Kanter's (1977:210-214) theory of proportional representation implies that the performance pressure on minorities decreases as their proportion increases in workplace. So, a group's performance is expected to enhance as the minority-majority ratio approaches parity (that is heterogeneity). In contrast, as homogeneity fosters trust and cohesion and facilitates communication (McPherson et al. 2001) it should enhance group performance.

Empirically, and supporting Kanter, the proportion of women was found positively correlated to an organization's profitability, which may be considered a proxy for performance (unpublished data for JK Hellerstein, D Neumark and KR Troske cited in Reskin et al. (1999:350)). In contrast, Allmendinger and Hackman (1995:435-437), in their study of 78 symphony orchestras, found that measures of performance decline
as the proportion of women increases until it approaches 50 percent, then, the downward trend flattens or reverses.

3.5 Measuring Workplace Segregation

The level of workplace segregation can be quantified using one of segregation indices. Although researchers have shown a great interest in studying and measuring segregation at different levels (by residence, occupation, job, and workplace), no consensus has emerged on how segregation should be measured, nor what the best measure is.

One reason for this lack of consensus (as discussed in Chapter 2) is the complexity of the concept of segregation which has many dimensions (Massey & Denton 1988). Another reason, proposed by James and Taeuber (1985), is the absence of a clear definition of segregation:

"the absence of a clear set of criteria, derived from a comprehensive definition of segregation, which can be used to evaluate the different measures that have been proposed."

(James & Taeuber 1985:2)

Duncan and Duncan (1955) showed that most segregation indices can be expressed as a function of the geometrical construct segregation curve (1955:210). In the following, a summary is presented of the segregation curve and some of the popular segregation indices.

3.5.1 The Segregation Curve

The "Segregation Curve" is the core concept in the literature on segregation indices. It is usually plotted to give a whole picture of segregation, and to compare segregation between two or more populations. Following Duncan & Duncan (1955), to illustrate how to plot the segregation curve, suppose that there are a number, $F$, of
firms in total. The firm $i$ contains $c_i$ Coptic workers and $m_i$ Muslim workers, totalling to $t_i = c_i + m_i$. The total number of Coptic workers is $C = \sum_{i=1}^{F} c_i$, the total number of Muslim workers is $M = \sum_{i=1}^{F} m_i$, and the total number workers is $T = \sum_{i=1}^{F} t_i$. For each firm, the Copts proportion, $p_i = c_i / t_i$, is computed, then, firms are arranged in descending order according to the value of $p_i$. Then, we compute the cumulative proportions $X_r = (c_1 + c_2 + \ldots + c_r) / C$ and $Y_r = (m_1 + m_2 + \ldots + m_r) / M$ of Copts and Muslims respectively. The segregation curve is the function $Y_r = f(X_r)$, as graphed in Figure 3.1. This segregation curve, together with the overall Copts proportion $P = C / T$, contains all the necessary information to calculate most of the segregation indices.

Figure 3.1: Hypothetical segregation curve
As plotted in Figure 3.1, the diagonal (the line segment $ab$) represents the case of complete integration (zero-segregation), the case where the proportion of Coptic workers within each firm equals the proportion of Copts in the workforce, i.e., $P_i = P$ for all $i$. On the other hand, the case of complete segregation is represented by the curve $afb$ (the horizontal and vertical axes), and it is the case where Copts and Muslims never work together in the same firm. The position of the segregation curve (aceb) relative to the diagonal (complete integration) and the curve $afb$ (complete segregation) indicates the level of workplace segregation.

Segregation curves can be used to compare levels of segregation among several populations. For example, the curves B and C, in Figure 3.2, represent higher levels of segregation than that of curve A. However, it is problematic to compare levels of segregation when segregation curves cross (the case of the curves B and C in Figure 3.2). Using different segregation indices to compare segregation levels for crossing
segregation curves may produce contradictory results. In this case, the researcher should put some weights to each part of the curves, and compare the curves according to these weights. For example, if the lower part (below the crossing point e), which represents firms with high proportion of Coptic workers, should contribute more to the level of segregation, then curve B should be considered to represent higher level of segregation than curve C.

As will be shown below, most of the segregation indices measure or describe this relative position of segregation curve.

### 3.5.2 Gini Index

The Gini index, $G$, was developed by Jahn, Schmid, and Schrag (1947). One mathematical expression for the Gini index is given by James & Taeuber (1985:5):

$$ G = \frac{\sum_{i=1}^{F} \sum_{j=1}^{F} \hat{t}_{ij} |p_i - p_j|}{2F^2P(1-P)} $$  

The numerator in Gini index is the weighted mean of the absolute value of all possible differences between firms in the proportion of Copts. The denominator is the maximum possible value for the numerator. With reference to the segregation curve in Figure 3.1, the Gini index represents the size of the area between the segregation curve and the diagonal (the dotted area) expressed as a proportion of the total area under the diagonal (Duncan & Duncan 1955:211).

Like other segregation indices discussed here, $G$ varies between 0 and 1. It attains the value 0 in the case of complete integration (where the segregation curve coincides the diagonal, that is, when $p_i=P$ for all $i$); and attains the value 1 in the case
of complete segregation (where segregation curve coincides with the curve $afb$, in this case $p_i$ may be either 0 or 1).

3.5.3 Index of Dissimilarity

The index of dissimilarity, $D$, is one of the most often used segregation indices in empirical research because it is simple to calculate and easy to interpret. $D$ is the maximum vertical distance between the diagonal and the segregation curve in Figure 3.1 (Duncan & Duncan 1955:211). One simple expression for $D$ is given by James & Taeuber (1985:6):

$$D = \sum_{i=1}^{L} \left| p_i - P \right| / 2TP(1-P)$$

$D$ is the weighted mean of the absolute deviation of proportion of Copts in each firm, $p_i$, from Copts proportion in the workforce, $P$, expressed as a fraction of its maximum. $D$ can also be interpreted as the proportion of Coptic (or Muslim) workers that should be displaced from their firms in order for Copts and Muslims to be proportionally represented in all firms, that is, in order for $p_i=P$ for all $i$. That is why $D$ is sometimes called the displacement index (Duncan & Duncan 1955:211).

3.5.4 Cowgill's Index

Cowgill and Cowgill (1951) developed their index to measure residential segregation, and they argued that an adequate measurement of segregation must be based on small residential units, such as blocks, because this would reveal the real lines of division between majority and minority populations. In the context of workplace segregation, the general form of Cowgills' Index, $Co$, is the ratio of the number of
Muslim workers working in firms containing only Muslims to the total number of Muslims.

In Figure 3.1, the Co index represents the length of the part be of the segregation curve which coincides with the vertical line bf.

3.5.5 The Variance Ratio Index

The Variance Ratio Index, \( V \), is given by (James & Taeuber 1985:8):

\[
V = \frac{\sum_{i=1}^{l} t_i (p_i - P)^2 / TP(1-P)}{TP(1-P)}
\]

Thus, \( V \) is the weighted mean square deviation of \( p_i \) from \( P \) expressed as a fraction of its maximum possible value.

3.5.6 The Information Theory Segregation Index

The Information Theory Segregation Index, \( H \), was introduced by Theil and Finizza (1971), and is defined by (James & Taeuber 1985:8):

\[
H = \frac{\sum_{i=1}^{l} t_i (E - E_i) / ET}{ET}
\]

Where:

\[
E = P \log_2 \left( \frac{1}{P} \right) + (1 - P) \log_2 \left[ \frac{1}{1 - P} \right]
\]

\[
E_i = p_i \log_2 \left( \frac{1}{p_i} \right) + (1 - p_i) \log_2 \left[ \frac{1}{1 - p_i} \right]
\]
H is considered as a measure of the average extent to which the overall ethnic (or religious) composition differs from that of each firm expressed as a fraction of its maximum possible value.

3.5.7 **Atkinson’s Family of Inequality Indices**

This family of inequality indices was introduced by Allison (1978) to measure the inequality in the distribution of income. However, it can be adapted as a measure of segregation. It can be expressed as (James & Taeuber 1985:9):

\[
A = \frac{P}{1-P} \left\{ \sum_{i=1}^{P} (1-p_i)^{\delta} \right\}^{\frac{1}{\delta}} \left\{ \frac{P}{1-P} \right\}^{\frac{1}{1-\delta}}
\]

Where \( \delta \) is a shape parameter, which ranges from 0 to 1. This parameter indicates how to weight the increments to segregation contributed by firms located at different place on the segregation curve. For values of \( \delta>0.5 \), firms with \( p_i>P \) produce a larger increment to \( A \) than do firms with \( p_i<P \). When \( \delta=0.5 \), firms will have the same importance regardless the values of \( p_i \). The correct selection of \( \delta \) may help solving the problem when comparing levels of segregation of two populations when segregation curves cross, as discussed before.

3.5.8 **Evaluation of Segregation Indices**

As noted before, different indices may produce different, and sometimes contradictory, implications about the segregation level. So, it is very important to select the right index based on the assumptions and objectives of each study. However, there are a set of desirable properties that any index should satisfy. James and Taeuber (1985) outlined these properties as follows:
1. **Organization Equivalence:** the measured level of segregation should not be changed if one firm is divided into a number of firms with an identical proportion of Copts, or if two or more firms with the same proportion combine into one.

2. **Size Invariance:** the measured level of segregation should be unaffected if the numbers of workers, Muslims and Copts, in each firm are changed with a constant proportion.

3. **Transfers:** segregation level should be reduced if Coptic workers move from firms of higher to lower proportion of Copts (or if Muslim workers move in the opposite direction).

4. **Composition Invariance:** proportional changes in the numbers of workers of a specific religion in each firm should not affect the measured level of segregation. For example, if the number of Coptic workers is doubled in each firm, this should not affect the segregation index.

5. **Lorenz Criterion:** if segregation curve A is somewhere above and nowhere below the segregation curve B, then the segregation index should rank A as having lower segregation than B.

Table 3.1 summarizes how the six segregation indices previously presented satisfy some or all of the five desirable properties listed above, with each property corresponding to one column, and with "Y" in any cell indicating that the corresponding index in the row satisfies the property in the column and "N" indicating the opposite. The table shows that only two indices, $G$ and $A$, satisfy all five properties. Beside these properties, the popularity, simplicity, and its clear relation to the segregation curve make $G$ the preferred index to use in the current thesis.
Table 3.1: Evaluation of segregation indices.

<table>
<thead>
<tr>
<th>Indices</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gini, G</td>
<td>Y Y Y Y Y</td>
</tr>
<tr>
<td>Index of Dissimilarity, D</td>
<td>Y Y N Y N</td>
</tr>
<tr>
<td>Cowgills’ Index, Co</td>
<td>Y Y N N N</td>
</tr>
<tr>
<td>The Variance Ratio Index, V</td>
<td>Y Y Y N N</td>
</tr>
<tr>
<td>The Information Theory Index, H</td>
<td>Y Y Y N N</td>
</tr>
</tbody>
</table>

3.5.9 Modified Gini Index

The standard Gini index (G), like most other segregation indices, measures the deviation of the distribution of workers (represented by the segregation curve aceb in Figure 3.1) from the diagonal straight line ab which represents the case in which all workplaces have the same proportion of Copts. As Carrington and Troske (1997) show, it is quite possible, even with a completely random allocation of workers to firms, that the segregation curve is not identical to the diagonal line (especially in the case of firms of small sizes and/or low a proportion of the minority group P). For example, with a 10 percent proportion of minority, it is impossible for firms with a number of workers of 7, 15, or any other number not divisible by ten, to have perfect proportional representation for minority and majority groups (since we can not have 0.7 or 1.5 worker(s)). This implies that, even with the random allocation of workers to firms, the index of segregation, G, will be greater than zero.
Carrington and Troske (1997) suggested a modified Gini index, $\hat{G}$, which measures the deviation of segregation curves from the curve of randomness (which represents the case in which workers are randomly allocated to firms) (as presented by the dotted area $x$ in Figure 3.3):

$$
\hat{G} = \begin{cases} 
  G - G^* & \text{if } G \geq G^* \\
  \frac{1 - G^*}{G - G^*} & \text{if } G < G^*
\end{cases}
$$

Where $G$ is the calculated standard Gini index and $G^*$ is the calculated Gini index if the workers (with minority proportion $P$) were randomly distributed to the firms (with the given sizes). $\hat{G}$ can take a negative value when the segregation curve lies above the random curve and closer to the diagonal of evenness. In this case the negative value of $\hat{G}$ not only indicates that there is no segregation in the workplaces but also indicates a higher tendency of people to work with others of different groups than to work with same-group people.

The modified Gini index is more suitable for the proposed models in this thesis than the standard Gini index, or other indices which measure the deviation from the evenness, for two reasons. Firstly, we are interested in simulating a labour market where $G^*$ can be calculated by simulating a random allocation of workers, with given $N$ and $P$, to a number of firms $F$, with specified size distribution. The value of $G^*$ used in subsequent sections is the average of value obtained through 200 simulations of a random allocation of workers to firms (see Appendix C for the NetLogo code of this simulation).
with small-to-medium firms (which increases the possibility of getting a high Gini index with a complete random allocation of workers). Secondly, we are particularly interested in measuring the systematic rather than random changes in workplace segregation. So when the model indicates an increasing level of workplace segregation this should be related to the behaviour of the agents and the model’s settings rather than to random effects.

3.6 Workplace Segregation and Hiring Discrimination in Egypt

This section presents an assessment of workplace segregation and hiring discrimination based on religion in Egypt. The objective here is not to give an accurate measure for workplace segregation as there are no data available for this purpose, but rather to give an overview of the phenomenon. The assessment is based on data from the Workers’ Status in Industrial Enterprises Survey (WSIES) for
detailed description of WSIES see Section 6.4). Only a subsample of those small-to-medium enterprises with between 10 and 50 workers inclusive are considered. This subsample includes 165 enterprises with 1765 workers.

3.6.1 Workplace Segregation

Within the subsample, 93 (around 5.4 percent) of 1728 workers were Copts. With the absence of workplace segregation, one would expect the proportion of Copts in each firm to be close to 5.4 (which is the overall proportion of Copts in the subsample). However, the data show that this is not the case. As Table 3.2 presents, about 81 percent of enterprises (133 enterprises) have no Copts at all.

Table 3.2: Frequency and percent of distribution of percentages of Copts.

<table>
<thead>
<tr>
<th>Percentage of Copts</th>
<th>Number of Firms</th>
<th>Percentage of all firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>133</td>
<td>81</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>25</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>30</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>36</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>50</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>60</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>70</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>80</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>100</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>165</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: based on data from (WSIES 2005).
The Copts are distributed over 32 enterprises (out of 165), and the distribution exhibits a high level of segregation. For example, 27 enterprises (84 percent) of those enterprises with Coptic workers have 10 percent or more Copts, 8 enterprises (25 percent) have 50 percent or more Copts, and one enterprise was found to employ only Copts (see Figure 3.4).

Figure 3.5 presents the segregation curve for the subsample of WSIES data. The segregation curve is very close to the horizontal and vertical lines $ab$ and $bc$ respectively indicating a high level of segregation.

The level of segregation can be quantified using one of the segregation indices presented earlier in Section 3.5. Using WSIES data, the Gini index, $G=0.932$, which indicates a high level of segregation. The Dissimilarity Index was also computed, $D=0.825$, which means that about 83 percent of the Coptic (or Muslim) workers would have to change their workplace in order to attain perfect integration at Egyptian
workplaces (when the proportion of Copts in each firm equals their overall proportion) (Duncan & Duncan 1955:211).

Comparing that level of workplace segregation in Egypt with other studies may give a clearer picture of its magnitude. For example, using Worker-Establishment Characteristics Database (WECO) from 1990, Carrington and Troske (1998:243) estimated the Gini coefficients of Black-White interfirm segregation in a sample of manufacturing establishments. They found high levels of segregation at the national level (with Gini coefficient, $G=0.78$) and more modest segregation when computed as a weighted mean of the index's values for different geographic areas (weighted Gini coefficient is 0.60). This shows that there is a relatively high level of segregation in the Egyptian labour market compared to the US context.
3.6.2 Hiring Discrimination

The WSIES data provide strong evidence that employers practice hiring discrimination based on religion. As Figure 3.6 shows, there is a tendency for the employers to hire workers of the same religion as their own. Muslim employers hire only 1.5 percent of their workers from Copts (while Copts represent about 5.4 percent of total labour force in the subsample). Similarly, Coptic employers practice hiring discrimination against Muslim workers. They hire only 63.4 percent of Muslim workers (while they represent about 94.6 percent of the labour force).

Using the Chi-Square test of independence (results are shown in Table 3.3) confirms that there is a statistically significant relationship between employers' religious identity and the religious identities of hired workers. To measure the strength of the relationship, the Eta\(^3\) coefficient was calculated between Employers' religious identity (the independent variable, coded as 1-Muslim and 2=Copt) and the percentage of Coptic workers in the firm (the dependent variable), and it was 0.718 which is a high value indicating a strong relationship.

---

\(^3\) Eta coefficient is a nominal by interval measure of association.
Table 3.3 Distribution of workers by employer's religious identity.

<table>
<thead>
<tr>
<th>Worker</th>
<th>Employer</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Muslim</td>
<td>Copt</td>
</tr>
<tr>
<td>Muslim</td>
<td>1511</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>(1451)</td>
<td>(83)</td>
</tr>
<tr>
<td>Copt</td>
<td>121</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>(181)</td>
<td>(10)</td>
</tr>
<tr>
<td>Total</td>
<td>1632</td>
<td>93</td>
</tr>
</tbody>
</table>

The numbers between parentheses are the expected counts when assuming independence of employer and worker's religious identities.

Pearson Chi-Square = 411.42, degrees of freedom (d.f.) = 1, Significance < 0.05

Source: based on data in (WSIES 2005)
3.7 Chapter Conclusion

In this chapter, the concept of workplace segregation has been introduced, and the empirical literature about the factors affecting the demographic composition of workplaces has been reviewed. These factors were categorized into two groups:

1. Pre-hire factors which affect the hiring process:
   - Demand-side factors include: hiring discrimination, statistical discrimination, hiring practices, market-based incentives, and firm size.
   - Supply-side factors include: composition of labour pools; relative numbers, group power, and threat; labour costs and group status;
   - Information flow about vacant jobs (to be discussed in Chapter 4)

2. Post-hire factors which affect the employees’ turnover

Then, the negative consequences of workplace segregation were discussed at the worker, group, and firm levels. Some of the most popular indices of workplaces segregation were evaluated, and it was shown that the Gini and modified Gini indices are the most suitable for the current thesis.

Finally, an overview of levels of workplace segregation and hiring discrimination in Egypt based on data from WSIES showed that they are high.
4 SOCIAL NETWORKS AND SOCIAL SEGREGATION

4.1 Aims of This Chapter

This chapter provides a review of the literature about social networks as a means for job search and recruitment. Section 4.2 provides an introduction and definition of social networks, and explains the importance of studying social networks. In Section 4.3, the core principles of the network approach are discussed, and in Section 4.4 a brief historical background for social network analysis and some popular network models are presented. Then, Section 4.5 introduces the main theories of network formation, and Section 4.6 discusses the challenges in collecting social network data. The origins of social relations, and how social networks change during the life course are presented in Section 4.7 while social impact theory and the effects of social networks on individuals' behaviour are discussed in Section 4.8. The concept of social segregation is presented in Section 4.9. Section 4.10 discusses the use of social networks as a job-search method, and, finally, Section 4.11 discusses the relationship between social networks and workplace segregation.

4.2 Introduction

Understanding social networks, and the social processes that form them, is a central concern for many disciplines including sociology (Wasserman & Faust 1994). Social networks have been found to have important implications for attitude formation (Lee et al. 2004), social mobility (Lin 1999), getting a job (Granovetter 1973, 1995), cascading dynamics of fads and fashion, and diffusion of norms and innovation
(Watts 2002), the spread of infectious disease (Morris & Kretzschmar 1995, 1997), media and ICT use for information exchange at work (Haythornthwaite & Wellman 1998), and in personal communications (Licoppe & Smoreda 2005).

A social network is a set of actors ("nodes") and the relations ("ties" or "edges") between these actors. The nodes may be individuals, groups, organizations, or societies. The ties may fall within the same level of analysis (e.g., individual-to-individual ties) or may cross levels of analysis (for example, individual-to-group ties) (Wasserman & Faust 1994).

4.2.1 Ego-centric, Socio-centric, and Open-system Networks

Based on the main subject and focus of research, social networks can be classified into three kinds: ego-centric, socio-centric, and open-system networks.

Ego-centric network studies concentrate on specific actors or "egos" and those who have relations with them, called alters. That is, from the participant's perspective, ego-centric networks constitute a "network of me" or a network of actors (alters) with whom the participant has some relationship. Socio-centric networks are considered closed systems, or networks in a box. Networks of children in a classroom or of workers in a firm are closed system networks and the ones most often studied in terms of the fine points of network structure. Open system networks are networks in which the boundaries are not necessarily clear; they are not in a box. A society itself is an example of this kind of open system networks.

4.2.2 Essential Dimensions of Social Ties

Network ties can be classified into a number of categories according to their nature (Katz et al. 2004). These include communication ties (such as who talks to whom, or who gives information or advice to whom), formal ties (such as who reports to whom),
affective ties (such as who likes whom, or who trusts whom), material or work flow ties (such as who gives money or other resources to whom), proximity ties (who is spatially or electronically close to whom), and cognitive ties (such as who knows who knows whom).

However, actors may share more than one type of tie (described as sharing a multiplex tie). For example, two academic colleagues might have a formal tie (one is an assistant professor and reports to the other, who is the department chairperson) and an affective tie (they are friends) and a proximity tie (their offices are two doors away) (Scott 1991).

Network ties can also be categorized according to the tie strength into strong ties (such as immediate family members and close friends) and weak ties (such as acquaintances) (Granovetter 1973, 1995). According to Granovetter:

"the strength of a tie is a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie." (1973:1361)

The distinction between strong and weak ties involves a multitude of facets, including affect, mutual obligations, reciprocity, and intensity. Strong ties are particularly valuable when an individual seeks socioemotional support (Wellman 1990) and often entail a high level of trust. Weak ties are more valuable when individuals are seeking diverse or unique information from someone outside their regular frequent contacts. This information could include new job or market opportunities.

Ties may be symmetric (nondirectional) (for example, X attends a meeting with Y) or asymmetric (vary in direction) (for example, X gives advice to Y vs. X gets advice from Y). Ties may also vary in content (for example, X talks to Y about the weather and to Z about sports), frequency (daily, weekly, monthly, etc.), and medium (face-to-
face conversation, written memos, e-mail, instant messaging, etc.). Finally, ties may vary in sign, ranging from positive (X likes Y) to negative (X dislikes Y) (Scott 1991).

4.3 Core Principles of Network Approach

Wellman (1988) has identified five fundamental principles that provide some "underlying intellectual unity" to the network approach.

1. People's behaviour is best predicted by examining the web of relationships in which they are embedded rather than examining their drives, attitudes, or demographic characteristics. That web of relationships presents opportunities and imposes constraints on people's behaviour.

2. The focus of analysis should be the relationships between units, rather than the units themselves or their intrinsic characteristics.

3. Analytic methods must not hinge on the conventional assumption of independence. A population or sample is defined relationally rather than categorically. Therefore, interdependence among units is assumed.

4. Understanding a social system requires more than merely aggregating the dyadic ties. The flow of information and resources between two people depends not simply on their relationship to each other but on their relationships to everybody else.

5. Groups sometimes have fuzzy rather than firm boundaries. The building blocks of organizations are not discrete groups but rather overlapping networks. Individuals generally have cross-cutting relationships to a multitude of groups.
4.4 Historical Background for Social Network Analysis

The roots of social network analysis go back to the 1930s with a group of German psychologists specialized in "Gestalt psychology" (associated principally with the work of Max Wertheimer, Wolfgang Köhler, and Kurt Koffka) (Scott 1991). The word "Gestalt" in German means "shape" or "figure", and it was used to refer to a concept of "wholeness". The Gestalt Theory started as a theory of perception to explain how the human brain recognizes objects, and it proposes that figures are recognized as organized patterns or "wholes" that have properties distinct from those of their parts. For example, a dog is not recognized by first identifying its parts (feet, ears, nose, tail, etc.), and then inferring the dog from those component parts. Instead, the dog is perceived as a whole, all at once. According to Gestalt Theory, people have preconceived conceptual schemes, or patterns, built into their minds, and perception is a kind of pattern-matching process. So, the importance of structures is greatly stressed in this theory.

Jacob Moreno (1889-1974), one of the Gestalt psychologists, is considered the father of "Sociometry". Sociometry is a quantitative method for measuring social relationships. Moreno was studying whether the psychological state of individuals within a group is related to the relationships between the group members (Scott 1991). He invented the "Sociogram" as a diagrammatic representation of the relationships between people in a social group. Typically, sociograms consist of dots, or "nodes" that represent people, with the relations or connections between them represented by lines. In a book *Who Shall Survive* firstly published in 1934, Moreno described or alluded to many concepts that eventually defined social networks and their analysis (Moreno 1953).
4.4.1 Graph Theory and Random Network Model

Like a sociogram, a graph, in mathematical terms, is a structure or diagram consisting of points (vertices or nodes) that are connected by lines (edges) representing the relations between them. Graph theory is the branch of mathematics that describes these graphs. The history of graph theory goes back to 1736 with the paper written by Leonhard Euler on the famous problem of Seven Bridges of Königsberg.

One of the earliest attempts to model social networks dates back to the seminal work on random graph theory by Paul Erdős and Alfréd Rényi (the so-called E-R model) in the 1950s. The basic E-R model requires connecting a number of nodes through edges chosen randomly. The systematic study of random graphs was initiated by Erdős and Rényi with the original purpose of studying, by means of probabilistic methods, the properties of graphs as a function of the increasing number of random connections.

The next significant development in research on network analysis was the publication of a paper by Cartwright and Harary (1956), when they showed that sociograms such as Moreno's could be analysed using graph theory. Before Cartwright and Harary's work, social scientists who were working on sociograms had described the relations represented by their diagrams qualitatively using words. The significant contribution of Cartwright and Harary was to link these entirely qualitative sociograms of social science, with the quantitative analyses of graph theory.

4.4.2 The Small-World Problem

In 1967, the social psychologist Stanley Milgram conducted an experiment to estimate the average path length in a social network, and to test the hypothesis that members of any large social network (in his case, the population of the United States) would be connected to each other through short chains of intermediate
acquaintances; a phenomenon that had been colloquially known as "the small world problem".

In order to test this idea, Milgram introduced a simple experiment by sending packets to 296 randomly-selected individuals in Nebraska and Kansas, with the aim of sending the packets to one of two target persons in the Boston area. The task Milgram set for his subjects had the additional constraint that each person could send the packet (after recording certain demographic details about themselves) only to someone whom they knew on a first-name basis, and who they thought was more likely to know the target than they were themselves. To inform their decisions, Milgram provided some information about the targets, including their names, addresses, and occupations. He then tracked each of the packets, by requesting that participants tear off a card and mail it directly to him at Harvard.

The result of Milgram's experiment was as follows: out of 296 chains, only 217 chains started, and 64 completed. The number of intermediate nodes varied from 2 to 10, with a median of 5 and a mean of 6, which suggesting that the average number of intermediaries that connect any random two people in US is 6. This result was has been referred to by the phrase "six degrees of separation".

### 4.4.3 Granovetter and the Strength of Weak Ties

Another influential work in the development of contemporary social network analysis was Mark Granovetter's paper "The Strength of Weak Ties" which was developed from the "Small World" hypothesis proven by Milgram (Granovetter 1973). Granovetter was studying the ways in which people acquire information about job opportunities through their informal social contacts and the nature of links, or ties, involved in this transmission of information: are they "strong" or "weak" ties. Granovetter conducted a survey of successful job applicants in the Boston area of the United States. After interviewing 102 of these people, Granovetter noted that his
question about "whether the person whose information that led to a job was 'a friend';", often provoked the reply: "No, just an acquaintance". Granovetter developed the idea that the significant links (for information transfer) in a network are not the strong connections, but the weaker and more tenuous ones.

Based on the results of his survey, Granovetter found that strong ties within a network, for example those between close friends or family members usually create closed groups of people. For example, in a family, there may be close ties between parents and children, and also between the children, in effect creating "triangulated" groups of strong links. Weaker links, however, tend to connect between social groups. For example, we may have a friend who lives in a different country with whom we only make contact occasionally. However, this friend is likely to have an entirely different group of close contacts to our own, and our "weak" link puts us in connection with an otherwise far-removed social group. Without this weak link, we might have no contact with these other people at all.

In terms of job-hunters, Granovetter surmised that the close-knit groups of strong contacts were unlikely to provide job prospects because they were in effect "closed"; the members only have contact with each other, and the group is unlikely to be very large. In contrast, weak ties put a job hunter in contact with a much larger network, where through tenuous links, they are more likely to encounter someone who they had not heard about before, who was looking to employ someone. Granovetter's work is also significant because he was the first to introduce the concept of the network bridge. A network bridge is a link connecting different groups of close contacts that would otherwise be unconnected. This is exactly how the weak ties in a network act.

4.4.4 Small-Worlds Model

The work of Granovetter inspired researchers worldwide to look for small world phenomena in many different domains during the 1970s and 1980s. Another
breakthrough in network theory was made in 1998 when Duncan Watts and Steven Strogatz published a paper titled "Collective dynamics of 'small-world' networks" which provided a mathematical model and explanation for the small world phenomenon proven by Milgram (Watts & Strogatz 1998). This paper is considered to be one of the most influential works in the history of network theory.

As explained earlier by Granovetter, social networks contain both random and non-random elements. Non-randomness originates from the overlap of close friends, or strong ties, and it is manifested in cliques where friends of a given individual are more likely to be friends with each other than they are with other randomly chosen members of the population. However, each individual also tends to have some number of "random" friends who do not know the individual's other friends. These friends are generally not as close (in social terms) as an individual's best friends, and they represent weak ties. The properties of a social network are greatly affected by the amount of randomness. Non-random networks are usually highly clustered and have longer path lengths on average than random networks.

Watts and Strogatz showed that social networks can be modelled by controlling the amount of randomness. They started with a regular graph representing the state of complete non-randomness (regularity). For example, in the regular graph in the left-hand side of Figure 4.1, nodes are arranged into a circle where each node is connected to four other nodes: two to the left and two to the right. We can move in the direction of randomness by re-wiring the links between these nodes. Each link from node $j$ to node $k$, $L(j, k)$ is broken with a specific probability $p$, and when a link is broken we choose a new node $k'$ with uniform probability and replace the link $L(j, k)$ with the link $L(j, k')$. As $p$ increases the network loses structure (regularity) and becomes more random (Watts & Strogatz 1998).
Since the conditions required for any network to be small-world are relatively weak (local clustering, combined with a small fraction of random shortcuts), many real-world networks are classified as small-world networks. Examples include the affiliation network of movie actors, and the power transmission grid of the western United States (Watts 2004).

4.4.5 Scale-Free Networks and the Importance of “Hubs”

Another key work in the field of network theory is that of Albert-Laszlo Barabasi (Barabasi et al. 2000, Barabasi 2002, Barabasi & Albert 1999). Barabasi found that in real-world networks there are often a number of nodes that are more connected than the others; they have far more links connecting them with other nodes than the average node. Barabasi called these nodes “hubs” and postulated that they have greater significance than other nodes, since when they are removed from the network, the impact of their loss on the entire network is greater than nodes that have relatively few connections.
Barabasi and Albert (1999) noticed that in many real-world networks, the degree distribution (the distribution of the number links for each node) is right-skewed with a “heavy tail”. That means a small number of nodes (hubs) are much better connected and have many more links than average, while the majority of nodes have less-than-average degree. A good example for this skewed distribution is the linking pattern in the World Wide Web, where a small number of websites, Google for example, receive links from millions of other sites, many more than the average site.

Real-world scale-free networks emerge based on the mechanism of preferential attachment which means that newly created nodes will tend to connect to already well-connected nodes rather than to poorly connected ones. Barabasi and Albert (1999) used a power-law formula to describe the degree distribution where the probability of a randomly chosen node having degree $k$ decreases as a power of $k$ and takes the form: $p(k) \sim k^{-\alpha}$, where the constant $\alpha$ (usually between 2 and 3) determines the rate of decay.

The reason behind the name scale-free network is that when power-law distributions are plotted on a double logarithmic scale, a power law appears as a straight line with negative slope $\alpha$ (panel a of Figure 4.2), and this contrasts with a normal distribution, which curves sharply after a certain “cutoff” value (panel b of Figure 4.2). A cutoff therefore implies a characteristic scale for the degree distribution of the network, and because a power-law degree distribution lacks any such cutoff value, it is often called a scale-free distribution (Watts 2004).
4.5 Theories of Network Formation

Why do people create and dissolve network ties? And with whom? There are multiple schools of thought that approach these questions. These include theories of self-interest, theories of social exchange or dependency, theories of mutual or collective interest, cognitive theories, and theories of homophily.

4.5.1 Theories of Self-Interest

According to the rational self-interest paradigm, people form social ties in order to maximize their personal preferences and desires. Individuals consider the creation of ties as an investment in the accumulation of social resources or "social capital." They expect to deploy this social capital and reap returns on their investment in the form of opportunities from which they can profit (Coleman 1988).
4.5.2 Theories of Social Exchange

Theories of social exchange imply that people establish ties to others with whom they can exchange valued resources (Homans 1951). Whether a relationship will be sustained over time will depend on the payoffs to each of the two parties. Homans (1951) argues that when individuals or groups exchange valued resources, this is made possible due to a large-scale network of relationships. Individuals' motivation to create ties is based on their ability to minimize their dependence on others from whom they need resources and maximize the dependence of others who need resources they can offer.

4.5.3 Theories of Mutual Interest

The main premise of the theories of mutual interest and collective action is that mutual interests and the possibility of benefits from coordinated action often outweigh individual self-interests (Olson 1965). For example, Public goods theory argues that creating and maintaining public goods requires the development of communication networks. For individuals, the motivation to forge ties and form a group is to maximize their collective ability to leverage resources and mobilize for collective action in their environment.

4.5.4 Cognitive Theories

One of the most famous cognitive theories of network formation is Heider's (1958) balance theory. According to this theory, if two individuals are friends, they would have similar evaluations of other objects. The object can be a third person in a communication network. If the two individuals did not consistently evaluate the third person, they would experience a state of discomfort or "psychological strain" and would strive to reduce this cognitive inconsistency by altering their evaluations of either the third person or their own friendship (Heider 1958).
4.5.5 **Theories of Homophily**

The homophily principle implies that contact between similar people (that is, having the same race, ethnicity, religion, gender, social class, etc.) occurs at a higher rate than among dissimilar people (Lazarsfeld & Merton 1954, McPherson et al. 2001). The colloquial adage, "birds of a feather flock together" implies that similarity is thought to ease communication, increase predictability of behaviour, and foster trust and reciprocity. According to Lazarsfeld and Merton (1954), homophily can be classified into two types: **status homophily** and **value homophily**.

In **status homophily**, similarity is based on individual's status including the major sociodemographic characteristics such as race, ethnicity, sex, or age, and acquired characteristics such as religion, education, occupation, or behaviour patterns. On the other hand, in **value homophily**, similarity is based on values, attitudes, and beliefs.

There is a voluminous empirical literature documenting the effects of homophily of both types on the formation of social networks in a wide range of relationships. Homophily was found to affect the formation of intimate relationships such as marriage (Kalmijn 1998) and confiding (Marsden 1987), in addition to ties of school friendship (Shrum et al. 1988) and work relations (Ibarra 1995).

But why do people prefer to create social ties with others similar to themselves? Carley (1991) tried to explain this homophilous attitude based on a cognitive process. According to Carley, people are more likely to interact when they share knowledge with one another. Demographic similarity usually tends to indicate shared knowledge, so people tend to be attracted to similar others for ease of communication and the smooth coordination of activities.
4.6 Social Networks Data Collection

There is a long tradition concerning the techniques of collecting social network data; for an in-depth review, see Marsden (1990). Overall, some of key challenges of this kind of data collection are:

- Network boundaries are usually difficult to define
- People do not easily recall their network members, and need appropriate prompts to elicit them. In addition, networks are large in general, and different social network members may have differing importance depending on the phenomenon studied
- Information about network members needs to balance detail and the burden on interviewee.

4.7 Origins of Social Relations

Kinship ties are the first source of social relations people have. When a person is born, he or she usually acquires a mother and father as primary kin, along with indirect ties to siblings and other relatives (Howell 1988). As years pass, people are introduced to different social circles and structure; for example, schools and workplaces, and their social networks become wider and more complex.

In a study of personal networks in the Toulouse area of France, Michel Grossetti examined the distribution of social ties and relations according to their origins (Grossetti 2005). According to Grossetti, contexts for constructing personal relations could be grouped into three types. Firstly, relations could be derived from “circles”. Circles are collective social forms or entities (for example, family, school, or other organizations). Interactions among members of the same circle may generate relations if sufficiently repeated.
Secondly, *relations may be constructed around common concerns*. A typical example of this context is neighbourhood. A neighbourhood does not necessarily imply a form of collective identification. However, it implies common concerns (for example, shared walls and utilities in a building) that facilitate the exchange of services (for example, loaning out garden tools, food items, and small maintenance favours). Thirdly, *relations could be derived from other relations*. This might happen when some people are introduced to us by other friends or during recreational or other social activities (Grossetti 2005).

The results of Grossetti’s study show that the majority of relations, about 59 percent, arise from circles (divided equally between families, 30 percent; and organizations, 29 percent); similar results were found by (Wellman 1990). The remaining relations are distributed between neighbourhoods (about 8 percent) and relations derived from other relations through the network (about 27 percent), for example, from husband/wife or through other friends, in addition to about 6 percent of relations constructed by other means such as chance acquaintances.

The results of Grossetti’s study show variation in the weight of each source of relation by age and level of education. For example, after the age of 25, the weight of familial relations tend to decrease, and other *constructed* relations tend to increase particularly those resulting from organized frameworks and relations arising from network effects; similar results was found by Marsden (1987). The proportion of relations from school/work increases with educational level whereas network effects diminish as educational level increases.

The importance of kinship ties was elaborated in Wellman’s (1990) work. He showed that the stronger the relationship used to define a network, the higher the proportion of the members who are kin. As presented in Table 4.1, Wellman (1990:199) shows that though kin represent only 0.3 percent of the potentially-available ties, they
Table 4.1: Number and percent of kin ties in average networks.

<table>
<thead>
<tr>
<th>Type of Ties</th>
<th>Number of Ties</th>
<th>Number of Kin Ties</th>
<th>% Kin Ties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potentially Available</td>
<td>16,000</td>
<td>55</td>
<td>0.3</td>
</tr>
<tr>
<td>Directly Available</td>
<td>2,700</td>
<td>55</td>
<td>2</td>
</tr>
<tr>
<td>Actual</td>
<td>400</td>
<td>35</td>
<td>9</td>
</tr>
<tr>
<td>Active</td>
<td>20</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>Interactor</td>
<td>10</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>Intimate</td>
<td>5</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>Confidant</td>
<td>2</td>
<td>1-2</td>
<td>50</td>
</tr>
</tbody>
</table>

Source: based on Table 1 in (Wellman 1990:199)

represent 50 percent of both intimates (distinctively close friends) and confidants: “the 1-3 network members to whom people pour out their hearts” (Wellman 1990:202).

The size of an ego-centric network is simply the number of alters in ego's social network, and “it provides a direct measure of the integration of the ego in the social life” (Marsden 1987:232). Although it may be easy to define, network size has been found to be difficult to measure directly (Killworth et al. 1990). People may not be willing to reveal some or all of their contacts, and it is hard to keep track of so much data (Pool & Kochan 1978).

For these reasons, researchers have searched for proxies for the of a person’s network instead of measuring it directly (Killworth et al. 1990, Marsden 2005). Methods used include personal diaries (Pool & Kochan 1978), counts of names that a respondent recognizes in telephone books (Freeman & Thompson 1989, Killworth et al. 1990), network scale-up estimates based on the likelihood of informants knowing members of some population groups of known sizes such as prisoners (Bernard et al. 1989, 1998, Killworth et al. 1990), surveys that ask respondents to name close
friends or members of support networks, that is, core networks (Grossetti 2005, Marsden 1987, McPherson et al. 2006, 1979, Wellman 1990), number of Christmas cards sent by informants (Hill & Dunbar 2003), and the “reversal small-world” technique in which respondents are given a long list of target persons and are asked to record to whom they would send the messages if they were initiating a small-world experiment (Killworth & Bernard 1978).

As presented in Table 4.1, Wellman (1990) estimated about 16,000 adults are potentially available to ego for interaction, and 2,700 from them are potentially direct ties. Most people have about 400 actual ties, and only 5 percent (20) of them are active or strong ties (those persons who are significant in one's life because of repeated sociable contact, supportiveness, or feelings of connectedness (Scott 1991:74)) while the remaining 95 percent are weak ties. From the active ties, people usually have about 10 frequent interactors, many of whom are neighbours or workmates, who are not necessarily intimates or close friends. About 25 percent of the active ties are considered distinctively close and supportive intimates, who tend to have equal numbers of kin and friends. Finally, there is a tiny set of two persons who are very socially-close or confidants (Wellman 1990:202).

Marsden (1987) used data from the 1985 General Social Survey to examine “core discussion networks of Americans”; interpersonal networks in which Americans discuss “important matters” (this may be analogous to “strong ties” as described by Granovetter (1973)). The results show that the mean size of such networks was 3 persons. Strikingly, nearly a quarter of respondents had networks of size 0 or 1. Overall network size was found to decrease with age, increase with education, vary by race/ethnic group, and be indifferent to gender. Nearly two decades later, McPherson et al. (2006) replicated the study of Marsden (1987) to assess social change in core network structure based on 2004 General Social Survey data. The mean network size had decreased by about a third, from 3 in 1985 to 2.08 in 2004.
4.7.1 Social Networks' Change During Life Course

An important question in the area of social networks is how networks change in size and composition as people move through the life course (Bott 1971, Kalmijn 2003). Kalmijn examined how social networks change with the transition through five life course stages: entering an intimate relationship, living together with the partner, having children with the partner, the children growing up, and children leaving the parental home (2003:234).

Kalmijn's study provides further empirical evidence for the dyadic withdrawal hypothesis which argues that friendship networks become smaller when people enter a cohabiting relationship and that friendship networks become more overlapping with the partner during the course of the relationship (Bott 1971, Johnson & Leslie 1982, Milardo 1982, Parks et al. 1983).

Sociological studies provide evidence that among married persons, there is a negative association between the duration of the marriage and the size of the friendship networks (Fischer & Oliker 1983, Wellman et al. 1997). Social-psychological studies also find that people who begin dating have fewer contacts with friends than others (Johnson & Leslie 1982). When the dating relationship becomes more serious, the overlap in the two friendship networks becomes larger, as is indicated by the frequency with which people have contact with the friends of their partner (Milardo 1982) and the degree to which people like the friends of their partner (Parks et al. 1983).

The dyadic withdrawal hypothesis has several implications. Joint social networks are a form of marital capital (Kalmijn 2003). The more friends spouses have in common, the more dependent they become on each other. Like having children, joint social networks increase the exit costs of marriage because both spouses usually lose more friends after divorce if they have most of their friends in common. Another implication
from the dyadic withdrawal hypothesis and the overlap of social networks is related to behaviour and attitude formation and change. Shared personal networks of husbands and wives provide an environment of value consensus for the couple, which may lead to more traditional sex roles in the family, or at least to more norm-conforming patterns of behaviour (Bott 1971).

Two arguments are presented to explain why network changes would occur. Firstly, the principle of competition argues that friends and spouses fulfil similar functions, thereby competing with each other for ego's time (Johnson & Leslie 1982). So, with dating and cohabitation, some (or much) of the time that was devoted to contacts with friends will be directed to the spouse and to children who may serve as an additional source of competition. However, it is still possible that the number of friends stays the same, while the frequency of contact and/or the amount of time people spend on each friend decline.

A second argument lies in the balance principle. According to Heider's theory of cognitive balance, triads between people should be transitive (Heider 1958). More specifically, the product of the three sentiment relationships in a triad—with positive values for liking and negative values for disliking—should be positive. If a strong positive relation exists between two persons (e.g., a couple), a negative product emerges when someone does not like the friend of his or her spouse. According to Heider's theory, such a situation causes "psychological strain" or tension which can be resolved by changing the value in one relationship or by dropping the relationship altogether. Which means that the person will either learn to like the friends of the spouse, or the spouse will discontinue the friendship (Parks et al. 1983). According to this mechanism, the number of shared friends will increase by keeping friends whom the spouse dislikes, and/or constructing new positive (may be strong) ties with the spouse's friends.
4.8 Social Impact Theory

People affect each other in many different ways.

"[W]e are drawn by the attractiveness of others and aroused by their mere presence, stimulated by their activity and embarrassed by their attention. We are influenced by the actions of others, entertained by their performances, and sometimes persuaded by their arguments... We are threatened by the power of others and angered by their attack. Fortunately, we are also comforted by the support of others and sustained by their love." (Latané 1981:343)

Latané called the effect that people exercise on each other "Social Impact", and defined it as:

"... any of the great variety of changes in physiological states and subjective feelings, motives and emotions, cognitions and beliefs, values and behaviour, that occur in an individual, human or animal, as a result of the real, implied, or imagined presence or actions of other individuals." (Latané 1981:343)

According to this definition, social impact is distinct from other concepts such as conformity, power, and authority. Conformity implies that an individual expresses a particular opinion or behaviour in order to fit in to a given situation or to meet the expectations of a given other, though he or she does not necessarily hold that opinion or believe that the behaviour is appropriate. Power involves the ability to force or coerce someone to behave in a particular way. Authority is the power that is believed to be legitimate (rather than coercive) by those who are subjected to it.

The social impact theory, developed by Latané (1981), proposes that the impact of any information source (for example, network alters) is a multiplicative function of three factors (or forces in Latané's terms):
1. Number of others who make up that source

2. Their immediacy, that is, their closeness in space or time, and absence of intervening barriers or filters

3. Strength, that is, salience, power, or intensity of the source.

Based on these ideas about social impact, Latané (1996) developed dynamic social impact theory to describe and predict the diffusion of beliefs through social systems. According to dynamic social impact theory, a social structure is a result of individuals influencing each other in a dynamic and iterative way. The likelihood of being influenced by someone nearby, rather than far away, (the immediacy factor noted above) produces localized patterns of consensus in attitudes, values, practices, identities, and meanings within communication networks. This process can lead initially randomly distributed attitudes and beliefs to become clustered or correlated; less popular beliefs become consolidated into minority subcultures. Dynamic social impact theory views society as a self-organizing complex system in which individuals interact and impact on each others' beliefs.

Most models involving social networks, including the models in the current thesis, adopt some of the assumptions of dynamic social impact theory. These include models of attitude formation (Lee et al. 2004), cascading dynamics of fads and fashion, and diffusion of norms and innovation (Watts 2002).

4.9 Social Segregation

The term "social segregation" is used here to mean the segregation of the ego-centric social networks of individuals in a society. An Individual's social network is said to be segregated based on some demographic characteristic (religion for example in case of Egypt) when people of different social groups (identified based on this characteristic) are not proportionally represented in the individual's social network.
For example, the empirical data showed that both Muslims and Copts tend to have their own social groups overrepresented in their social networks.

As discussed in detail in Chapter 3, social segregation poses restrictions on intergroup interaction; thus, it may lead to negative consequences; for example, stereotyping, prejudice, and discrimination. The main suggested cause of social segregation is the homophilous attitudes of individuals which creates a bias towards creating social links with similar others.

4.9.1 Measuring Social Segregation

In Section 3.5 in the previous chapter, some segregation indices have been presented. All these indices measure what is called "spatial segregation", that is, physical restrictions on people accessing some physical space. The focus of the current section is on measuring segregation in social networks, that is, the limitation on people interacting with each other.

The segregation index, $S$, developed by Freeman (1978) is the most popular and widely-used measure of social segregation. $S$ measures the deviation of the distribution of links between individuals from two different groups from the distribution expected when links are created at random, and it is given by the following formula (Freeman 1978:416):

$$S = \begin{cases} \frac{E(e^*) - e^*}{E(e^*)} & \text{if } E(e^*) \geq e^* \\ 0 & \text{Otherwise} \end{cases}$$

where $E(e^*)$ is the expected number of links between two individuals from different groups (intergroup links) under the assumption that links are created at random, while $e^*$ is the actual number of such links.
$E(e^*)$ is given by (adapted from Freeman 1978:418):

$$E(e^*) = \frac{2NLP(1-P)}{N-1}$$

Where $L$ is the total number of links in the global social network, $N$ is the number of individuals, and $P$ is the proportion of the minority group. Although Freeman has developed this index to measure segregation in social networks with undirected (symmetric) links, it can be shown that the formula is also valid for the case of directed links.

4.10 Using Social Networks as a Job-Search Method

Granovetter's work (1973, 1983, 1995) on the role of social ties in the process of information diffusion provides much of the conceptual basis for studies of the diffusion of information about job openings. Social networks emphasize two functions that personal contacts may play in the labour market. First, contacts can provide job seekers with timely information about employment opportunities. Second, contacts can refer (or recommend), or sponsor job seekers thereby improving their chance of acquiring particular jobs (Elliott 2001).

A huge literature has been devoted to studying how social networks and social ties affect job search methods and outcomes (for example, Battu et al. 2004, Elliott 2000, Elliott & Sims 2001, Wahba & Zenou 2005) and studying the importance of social ties to job-contacts especially what is known as “insider referrals” (for example Elliott 2001, Fernandez et al. 2000, Tassier & Menczer 2005). The following is a brief review of this literature.
4.10.1 Tie Strength

In "Strength of Weak Ties", Granovetter (1973) demonstrates that most individuals attain jobs through social contacts rather than through formal channels. Besides, acquaintances (or weak ties) provide links to better jobs than do friends and relatives (or strong ties) because they are more likely to have different information than job searchers and their close friends.

However, tie strength does not affect all individuals in the same way. For example Wegener (1991), in his study about job mobility and social ties, argues that the "strength of weak ties" theory is "valid only for individuals in high social strata" (p. 69). He suggests that most networks are heterogeneous, and job seekers with low social status may be able to contact persons of higher status within their own network. These job seekers are able to exploit strong ties with the contact persons.

Individuals with high prestige positions must use weak ties to reach beyond the bounds of their network to contact persons with even higher prestige, which is usually more difficult. But one may find some contradiction in Wegener's argument. He does not explain why persons with high prestige positions do not have links to other persons with higher positions than their own as long if his assumption about the heterogeneity of the social networks is valid.

The relationship between using weak ties as a job-finding method and income level has been controversial. While many studies suggest that there is a little evidence of a relationship between weak ties and income (for example, Bridges & Villenevez 1986, Marsden & Hurlbert 1988), Tassier (2006) provides an empirical support for the notion that having more weak ties in one's social network increases income. Tassier (2006) showed that the methods used by previous studies to estimate the effect of weak ties on income usually underestimate this effect. These studies, usually, estimate the effect of job-finding method on income while controlling for other labour-
market variables (education, experience, gender, etc.). Specifically, these studies test the hypothesis that weak ties provide superior job information that leads to higher paying jobs. However, it is not necessary that weak ties specifically provide superior information to lead to better jobs. Weak ties can positively affect income through increasing the size of a social network. Individuals with a larger proportion of weak ties in their social network should expect to learn of more job information compared with individuals with a smaller proportion of weak ties:

"if there is an effect of weak ties on income, it is more likely to occur because having more weak ties in one's social network allows one to learn of more job information, not better job information" (Tassier 2006:706).

4.10.2 Network Structure

"Network structure" refers to the pattern in which social actors (or nodes) are connected to each other in a social network. As employee referrals are used in a widespread and purposive way, social structure is expected to play an important role in determining labour-market outcomes (Calvó-Armengol & Jackson 2007, Calvó-Armengol & Jackson 2004, Calvó-Armengol & Zenou 2005, 1994, 1992, Montgomery 1991, Tassier & Menczer 2005).

Social integration and network structure of both minority and majority groups were found to have direct implications for employment levels. For example, Tassier and Menczer (2005) introduced an agent-based simulation model of referral hiring to study the effects of social network structure on group level (rather than individual level) inequality. They used small-world network model (Watts 1999, Watts & Strogatz 1998) (as described in Section 4.4.4) as they started with a regular (or "non-random" as they called it) graph and controlled network structures (for the minority and majority groups) by "re-wiring" network links. To control the level of segregation, Tassier and Menczer started with two separate graphs, representing the case of
complete segregation, and used the re-wing technique again to create links across group boundaries with a controlled probability.

In addition to social networks of individual agents, Tassier and Menczer introduced another (small-world) network for jobs to show that the information about job vacancies that a referrer may provide are related to his job position relative to other jobs.

On the one hand, the results of the simulation showed that social networks with random links produce higher employment rates than those with more structured links if the population is integrated (low level of segregation in the social networks of minority and majority groups) or information flows about job vacancies are random. On the other hand, if the population is highly segregated and information flows about job vacancies are non-random then less random social networks have higher employment rates than more random social networks. In this case non-random social networks allow a group to better keep job information inside the group when a population is segregated.

Using agent-based simulation Calvó-Armengol and Jackson (2007, 2004) showed that employment is positively correlated across time and agents. That is employment statuses of any path-connected agents are positively correlated. When some agents are employed, then it is more likely for other agents in contact with them to receive job information from them. This holds even in different points in time, that is, for any two path-connected agents \( i \) and \( j \), agent \( i \)'s employment status at time \( t \) is positively correlated with agent \( j \)'s status at time \( t' \) for general values of \( t \) and \( t' \).

Moreover, Calvó-Armengol and Jackson found that unemployment exhibits duration dependence, that is, the probability of obtaining a job decreases the longer time that an agent has been unemployed. They examined also inequality between two arbitrary groups and showed that when one group starts with a worse employment status, then
that group's drop-out rate will be higher and their employment prospects will be persistently below that of the other group.

4.10.3 Network Size

Calvó-Armengol (2004) and Calvó-Armengol and Zenou (2005) were the first to study the effect of the size of social network on job attainment in a theoretical context. Using a job-matching model in which workers find jobs through social contacts, they show that having more social direct contacts increases the probability to find a job, whereas having more indirect (or two-links-away) contacts is detrimental in getting job information through social networks. Indirect contacts represent competitors and may get some of job information that otherwise one may get. So the overall effect of network size on job information and employment status is determined according to the relative effect of direct versus indirect contacts.

Wahba and Zenou (2005) presents empirical evidence for Calvó-Armengol and Zenou's ideas. They show that for employed individuals, the probability to find a better job through social networks is higher than other search methods, and this probability has a concave relationship with the size of the network. If each worker has more friends, and each of his/her friends has also more friends, this would create congestion in information transmission. For very dense networks, this congestion can be so important that it outweighs the benefits of large networks and the probability to find a job decreases. Also, the probability to find a job through social networks decreases with local unemployment rate (which is used as a measure of network quality). Because of a lack of data, Wahba and Zenou (2005) used the population density as a proxy for the size of social network. Therefore, their results should be taken with caution since the population density, itself, may be explained by available employment chances.
4.11 Social Networks and Workplace Segregation

There is very little literature on how using social networks for job search may affect workplace segregation. Tassier (2005) developed a Markov model to study the effects of using referral hiring on inequality between social groups and workplace segregation. According to this model, the population is divided into two groups (for example, men and women, or Blacks and Whites). There are a finite set of states, and the distribution of the two types of workers in a firm (for example, the percentage of female workers) determines its state. The transition probabilities that define the probability that a firm’s state changes to another state are determined by the distribution of worker groups in the unemployed population and the current state of the firm.

According to Tassier’s model, the level of workplace segregation increases with the increase of referral hiring. In the special case when all workers find their jobs by referral hiring, complete segregation in the workplace occurs. On the other hand, the model shows that referral hiring does not produce a group-level inequality, even in the case of complete segregation where the rate of unemployment will be the same for different groups.

In another study, Tassier (2007) used the previous model to study the potential of referral hiring to produce gender segregation. He validated the model against empirical data on staffing at US colleges and universities, and found that it generates a level of segregation close to the observed.

Although Tassier’s research is relevant to the current thesis, it differs in that it only considers the relation between referral hiring and workplace segregation in the steady state, and pays no attention to the causal mechanisms or the many possible paths that may lead to this state. Besides, because of computational complexity, he only considers the case when all firms are of equal size.
4.12 Chapter Conclusion

This chapter presented a brief introduction to social networks and social segregation. The chapters started with a definition of a social network, its classification into ego-centric, socio-centric, and open-system networks, and the dimensions of social ties. The principles of network-based research are discussed followed by a brief historical background on the evolution of social network analysis starting from Gestalt psychology in 1930s, reviewing the most popular network models: random model, small-world model, and scale-free model.

The chapter also discussed some popular theories of network formation including theories of self-interest, theories of social exchange or dependency, theories of mutual or collective interest, cognitive theories, and theories of homophily. Then it discussed the origins of social relations, the contribution of each origin to the construction of social networks, and how the relative importance of these origins changes during life course.

Social impact theory and how social networks affect individuals' behaviour were briefly introduced. Finally, the concept of social segregation was introduced, and the effects of using social networks as a job search method on workplace segregation were discussed.
5 AGENT-BASED SOCIAL SIMULATION

5.1 Aims of This Chapter

This chapter aims to introduce agent-based modelling (ABM) as a research method. Firstly, social simulation is defined in Section 5.2, and typical objectives of simulation research are discussed in Section 5.3. In Section 5.4 simulation is discussed as a research method, and it is compared with mathematical and statistical modelling in Section 5.5. The epistemologies of social simulation are discussed in Section 5.6, and the complexity of social systems is discussed in Section 5.7. In Section 5.8, ABM is discussed as a specific approach within social simulation in general, while Section 5.9 provides justification for using ABM as a research method for the current thesis. Finally, in Section 5.10, Shelling's model of segregation is introduced as a relevant example of social simulation.

5.2 What Is "Social Simulation"?

Simulation can be defined in many ways. According to the New Oxford English Dictionary (2001), simulation is:

"the technique of imitating the behaviour of some situation or process (whether economic, military, mechanical, etc.) by means of a suitably analogous situation or apparatus, esp. for the purpose of study or personnel training".

Social simulation, then, is an imitation of some social process or social phenomenon. According to this definition, simulation is a method of modelling (imitation mean
modelling in some sense) real systems and processes to create a model analogous (that is similar) to the real system (Gilbert & Troitzsch 2005:1). The very general purpose of this modelling activity is to understand a real world or a “target” system through simplification.

“A model is a simplification – smaller, less detailed, less complex, or all of these together – of some other structure or system. A model aeroplane is recognizably an aeroplane, even if it is much smaller than the real aeroplane and has none of its complex control system” (Gilbert & Troitzsch 2005:2)

The model should be less complex than the real system, and should improve our understanding of how the real system functions or might function. By formalizing concepts and theories, the model is (or should be) more precise than the textual description of the system and its processes, therefore simulation can be used as a method of theory development (Gilbert & Troitzsch 2005:3).

5.3 Objectives of Simulation

Simulation can be used for diverse purposes (Axelrod 1997b). It can be used for prediction (e.g., weather forecasting), performance (e.g., diagnosis, speech recognition, and function optimization), training (e.g., flight simulators for pilots), entertainment (e.g., flight simulators and computer games), education (e.g., simulations of medical interventions), proof for certain theory or hypothesis, discovery of new laws and relationships.

Epstein (2008) argues that social scientists are building models all the time, when making projections or describing social dynamics (for example, epidemic, war, or migration). The question then is not whether to build models; but, whether to build
'explicit' ones (Epstein 2008:2). Epstein also argues that the 'ability to predict' is not a necessary characteristic of good models. Most complex systems ¹ (including most social systems) are not predictable. The main objective of the good model then is to explain the phenomenon and its dynamics rather than to predict it. Waldrop (1993) supports Epstein about the importance of explanation, and comments:

> "predictions are nice, if you can make them. But the essence of science lies in explanations, laying bare the fundamental mechanisms of nature...Was Darwin 'unscientific' because he couldn't predict what species will evolve in the next million years? Are geologists unscientific because they can't predict precisely where the next earthquake will come, or where the next mountain range will rise? Are astronomers unscientific because they can't predict precisely where the next star will be borne?" (Waldrop 1993:39)

In addition to prediction (if possible), Epstein (2008:2-3) gives sixteen reasons to build a model; these include:

- Explain a phenomenon and how/why it happens.
- Help identifying core dynamics.
- Guide data collection. A model makes it clearer what parameters we should focus on, and what data should be collected.
- Discover new research questions.
- Suggest dynamical analogies among a wide range of models that may seem unrelated. For example, Samuelson (1972) showed that we can connect the structural relations of monopolistic firms with those that prevail for an entropy-

¹ Complex systems will be introduced in more detail in Section 5.7.
maximizing thermodynamic system, where the relationship between absolute temperature and entropy is the same as the relation that the wage rate has to labour, or the land rent has to acres of land (Samuelson 1972, cited in Epstein 2008).

5.4 Simulation as a Method

In social research, models can be broadly classified into: statistical (or mathematical) models and simulation models (Gilbert & Troitzsch 2005). Both kinds of models involve some level of abstraction for a social process or a target system. The model is usually a set of mathematical equations, in case of mathematical models, or a computer program, in case of simulation. And both are validated by comparing the predicted/simulated data with observed or collected data.

The methodological process of modelling is very similar for simulation models and statistical models, and can be broken down into the following steps (as illustrated in Figure 5.1).

![Diagram of the simulation process](image)

**Figure 5.1: The logic of simulation as a method**
(Based on Gilbert & Troitzsch (2005:16-17))
• Firstly, the ‘target’ for modelling is specified and defined. This target could be a social process or some phenomenon of interest; for example, dynamics of residential segregation (Schelling 1971).

• Some data may be gathered at this stage to get a better understanding of the target.

• Since the target system in most social systems is a complex one, some abstraction is needed of the target to a conceptual model. This model could be a set of mathematical equations, in case of statistical modelling, or a computer program in case of simulation.

• Once the (statistical or computational) model has been developed, data will be needed again to estimate model’s parameters during parameter estimation phase.

• Then, in case of statistical models, the model can be used to generate some predicted data; while in the case of simulation, the model is left to run to generate some simulated data.

• Finally, the model has to be validated. This is measured by the similarity between the model’s output (that is, simulated or predicted data) with the collected data.

5.5 Simulation versus Mathematical Modelling

The main advantage of modelling social phenomena using a mathematical approach is that social entities are represented very precisely, and will be in a form to which mathematical or deduction techniques can more easily be applied. However, there are some difficulties usually associated with mathematical models of social phenomena. Firstly, they require a high level of ability in mathematics (which may be not available for many social researchers) to manipulate the equations. Secondly, these equations are often found not to be possible to solve (the issue of mathematical
intractability). Thirdly, as a result of intractability, limiting assumptions or simplifications when expressing relationships may be required in order to keep the problem amenable to mathematical modelling. For example, the mathematical treatment often necessitates that some quantities must be considered to be uniform and homogenous, which means that the method is really only suitable for the class of problems where entities can be represented as such (which is not the case for most social phenomena).

On the other hand, simulation models could be a better alternative in the following situations. Firstly, when the priority is to understand the underlying causal mechanisms, and to develop and test theories about the target system, rather than to make predictions based on the correlation among variables:

"We would expect a simulation model to include explicit representations of the processes which are thought to be at work in the social world. In contrast, a statistical model will reproduce the pattern of correlations among measured variables, but rarely will it be modelling the mechanisms which underlie these relationships." (Gilbert & Troitzsch 2005:18)

This distinction between statistical modelling and simulation modelling turns, then, on the concept of mechanism. Because computational simulation affords the possibility of layered models, where each layer corresponds to a layer of reality, simulation offers the possibility of modelling such mechanisms.

Secondly, when the phenomenon under study is a dynamic and complex one. In these cases simulation modelling has the following advantages over mathematical modelling (Gilbert & Troitzsch 2005:5-6):

- Computer program code is more expressive than systems of equations.
- Programs are better suited to modelling parallel processes.
Programs are (or can be) designed modularly and hence are easily modified.

Programs are more flexible to model the heterogeneity amongst social actors.

When the main objective of the research is to predict the level of a phenomenon, and the phenomenon under study is less complex, mathematical modelling may be a good choice. For example, accurate forecasts for numbers of students joining the university can be made by examining some time series of previous years and applying some mathematical equations to extend it to the future, with no understanding, or interest in understanding, the preferences of individuals regarding higher education or how they make decisions about it. On the other hand for complex phenomena, and when the research aims at understanding the mechanisms that govern the phenomenon, then simulation is the better choice.

5.6 The Epistemologies of Social Simulation

There has been a long debate between rationalists and empiricists on how scientific knowledge could be gained.

For rationalists, scientific knowledge should be gained through reasoning using deduction. We should start with a set of axiomatic-terminological conditions, concerning the final knowledge foundation, and then use deductive reasoning to extend our knowledge and develop theories. Deduction is considered a ‘top-down’ approach that works from theory to data. We start with a theory about some phenomenon of interest. Then, we refine it into more specific hypotheses, collect some data, and test these hypotheses. The conclusion then may be the confirmation/disconfirmation of the initial theory. A good example of the deductive approach is the use of rational-choice axioms to discover the equilibrium results in game theories (Axelrod 1997a).
Empiricists, on the other hand, claim that knowledge can only be gained using direct experience and observations (depending mainly on the senses), that is, using an inductive approach. Induction moves from specific observations to broader generalizations and theories, that is, it is a "bottom-up" approach. We begin with some observations and data and try to explore it to detect patterns and regularities, formulate some hypotheses, use the available data to test them, and finally develop some general conclusion or theory. The analysis of opinion surveys and macroeconomic data are examples where Induction is widely used.

5.6.1 Simulation as a Third Way of Doing Science

In addition to induction and deduction, simulation provides a third way of doing science that reconciles the rationalists' and empiricists' views (Axelrod 1997b:24). With simulation, and like deduction, one starts with a set of explicit assumptions (usually about the micro-level behaviour of agents); but, unlike deduction, these assumptions are not used to prove theorems (because this would be very difficult for complex systems), rather, these assumptions are used to build a computational model to generate data that can be analysed inductively (Axelrod 1997b:24) (The methodology for validating simulation models is discussed in Section 9.3).

5.6.2 Aims of Scientific Knowledge: Natural sciences versus Historian sciences

The differences between the natural and historian sciences are mainly about the epistemological aims and interests of both kinds of science. Wilhelm Windelband (1848-1915) and Heinrich Ricert (1848-1915) used the notions “nomothetic” (law-making and law-finding), to refer to natural science, and “idiographic” (individualistic and descriptive) for historical sciences. According to Windelband:
"[natural science] abstracts from the unique and qualitatively distinctive properties of real phenomena in order to disclose the laws on which they depend. This is the sense in which natural science is nomothetic. It has no intrinsic interest in the individual events of concrete reality [...] the ultimate theoretical purpose of natural science [...] is to produce a system of maximally abstract and general laws, nomological regularities that govern all events. The interest of historical science, on the other hand, is idiographic. Here the purpose of knowledge is to comprehend the distinctive properties of the unique event itself." (Oakes 1987:437ff cited in Gilbert & Ahrweiler 2007)

All scientific research can be placed somewhere in the nomothetic-idiographic continuum, where theoretical mathematics is placed at the extreme nomothetic side and narrative hermeneutical history on the other, idiographic, side.

According to Max Weber (1864-1920), social science encompasses both nomothetic and idiographic features. Idiographic features of social science are emphasized when the main objective is to investigate historical and single cases in order to explain why and how social phenomena happen.

"Social science is an empirical science of experienced reality. The aim is to understand social reality that surrounds us in its peculiar character -- on the one hand the contemporary framework and cultural meanings of all the single phenomena we observe now, and on the other hand, the reasons for their historical path that led to their special characteristics." [(Weber 1988:170f) cited in (Gilbert & Ahrweiler 2007:5)]

Nomothetic features of social science can be achieved through exact notions and rigorous process of concept formation using what Weber called "ideal types". An ideal type represents a conceptual extreme that is constructed from empirical reality and gives it a logical consistency. As Weber explains:
"The ideal type is constructed by partially emphasising one or more characteristics and by combining many diffuse and discrete, more or less - sometimes not at all - present individual phenomena - a procedure which allows one to build a unified thought concept from these partially emphasised characteristics. In its conceptual purity the ideal type does not exist in empirical reality, it is a utopia. For historical work the task remains to state for each single case how close or how distant reality comes to this thought concept" [(Weber 1988:191) cited in (Gilbert & Ahrweiler 2007:6)].

One can think of perfect competition of classical economic theory as an example of ideal types. The conditions and assumptions of the perfect competition model can not be found in reality; yet, it provides a valuable framework for many economic researchers to generate universally-valid results and conclusions.

5.6.3 Types of Simulation Models

Using this nomothetic-idiographic terminology, social simulation models can vary widely according to their epistemic aims (as illustrated in Figure 5.2). On the upper-left-side in Figure 5.2, we find nomothetically-oriented models of abstract social processes which seek to discover general "social laws" governing social phenomena. Examples of these models include models of abstract social processes such as innovation diffusion (Gilbert et al. 2001, Huang et al. 2005), segregation (Schelling 1971), behaviour dynamics (Axelrod 1981, Benvenuto 2000, Németh & Takács 2007), and opinion dynamics (Deffuant 2006, Gargiulo & Mazzoni, Hegselmann & Krause 2002, Salzarulo 2006, Stauffer et al. 2004).

On the other hand, idiographically-oriented models aim to understand and explain a special case, the history of an individual event. An example is the Axtell et al. (2002)'s model of the Kayenta Anasazi population in Long House Valley state where they try
to reproduce spatial and demographic features of the Anasazi from about A.D. 800 to 1300.

It is clear that the simulation models developed within this thesis belong to the empirically-grounded models category. Here, the emphasis is to test and develop theories of segregation of workplaces and social networks based on evidence from empirical data (and in-line with existing theories).

### 5.7 Social Systems as Complex systems

The complexity approach to studying social systems encompasses a collection of theoretical assumptions and system features. According to Waldrop (1993), a system is complex when many autonomous agents are interacting with each other in many ways:

*"Think of the quadrillions of chemically reacting proteins, lipids, and nucleic acids that make up a living cell, or the billions of interconnected neurons that make up the brain, or the millions*
of mutually interdependent individuals who make up a human society." (Waldrop 1993:11)

The human brain, as an example of a complex system, is a network of more than 100 billion agents (neurons). The interaction among these neurons leads to the emergence of various functions of the brain including perception, storing information, learning, and innovation (that is, to come up with new methods of solving problems).

According to Waldrop's definition, the characteristics of complex systems include (1993:11):

1. Complex systems consist of a large number of interacting agents, billions in the case of a brain, where each agent influences and is influenced by quite few number of other agents.

2. These interactions are non-linear; this is a necessary condition for a system to be complex.

3. These systems undergo spontaneous self-organization through the interactions of agents. For example, to satisfy their material needs, people unconsciously organize themselves into an economy through their buying and selling. In other words, there is no central authority or processor organizing the system, such as in a conventional computer.

4. These systems are adaptive, agents constantly learn from experience and history. For example, species evolve for better survival in a changing environment.

5. Complex systems possess a kind of dynamism, that is agents constantly change; acquiring knowledge for example. This makes them different from static objects such as computer chips or snowflakes.
Most social systems and social phenomena satisfy these characteristics, that is, they are complex systems. These characteristics of complex systems introduce some consequences about the system behaviour:

- **Unpredictability of the behaviour.** Complex systems are very sensitive to initial conditions, and small perturbations could make drastic change to the system behaviour, so they are unpredictable in general (or at least they cannot be accurately predicted).
- **Lack of decomposability.** A complex system, by definition, is the outcome of interacting components. So, disconnecting these components, or studying them separately (in a reductionist approach) is not possible.

### 5.8 Agent-Based Modelling

Agent-Based Modelling (ABM) is distinguished from other kinds of simulation research by its focus on the concept of **agents** as the core component units that compose the model. In this sense, agents can be thought of as intelligent, autonomous programs that interact with other components of the system and their environment in order to affect a certain set of programmed goals (Gilbert & Troitzsch 2005). This sociability or **social embeddedness** nature gives ABM an additional advantage, over other types of simulation modelling, when modelling social systems where individuals (agents) are continuously interacting with each other and with the environment (Edmonds 1998).

Edmonds defines this social embeddedness as follows:

"An agent is socially embedded in a collection of other agents to the extent that it is more appropriate to model that agent as part of the total system of agents and their interactions as opposed to modelling it as a single agent that is interacting with an essentially unitary environment." (Edmonds 1998:2)
According to this definition, an agent’s behaviour and cognition can be understood only in the context of interactions with other agents. In this framework, multi-agent systems usually incorporate some specifications of social interaction such as imitation, communication, persuasion, trading, bargaining, and so on, as an integral part of the model design. This implies that these processes will themselves be a central object of study.

5.8.1 Historical Origins of ABM

Social simulation is a young but rapidly growing method in social sciences (an overview of the origins and history of social simulation is found in Gilbert and Troitzsch (2005)). Agent-based modelling originated within the field of Distributed Artificial Intelligence (DAI). Artificial Intelligence (AI) is a branch of computer science concerned with simulating human intelligence and intelligent behaviour (Gilbert & Troitzsch 2005).

The classical approach of AI focused on individual cognition and does not involve "social" aspects of intelligence. In contrast, DAI (which has gained increasing research interest since the 1980s) is concerned with complex systems that consist of many interacting components (or agents) which have some level of autonomy and are both able to interact among themselves and interact with their environment to achieve certain goals. In these kinds of systems, social interaction is the mechanism of coordinating these various interacting components and their activities and achieving a useful outcome on the macro (or system) level.

DAI is characterised by a 'bottom-up' approach to system design, in which micro-level rules of interaction are specified (based on some assumptions or theories), and then macro-level patterns "emerge". In this 'bottom-up' approach there is no central control or blackboard system, rather control of the system is intended to emerge from the specification of interaction processes amongst the agents. The designer of this type
of system would exploit this property of complex systems to establish control and coordination rather than to program it directly. As a result of the influence of these interaction mechanisms, individual components will tend to behave in a regulated way. This will result in the system exhibiting structured behaviour at an aggregate level.

5.8.2 Emergence

Emergence is the key concept that places the DAI approach within the domain of complexity research (Waldrop 1993). Emergence implies that macro behaviours are generated by micro rules of interaction. As Gilbert and Troitzsch explain:

"Emergence occurs when interactions among objects at one level give rise to different types of objects at another level... a phenomenon is emergent if it requires new categories to describe it which are not required to describe the behaviour of the underlying components". (2005:11)

For example, an economy, as emergent phenomenon, can be described by some categories, for example growth rate, recession, and inflation, which are not applicable to describe individuals. Similarly, behavioural norms in human societies (such as fashion trends) and group behaviour of animals (flocking and herding) are emergent phenomena. Emergence is an important feature of most social systems where interactions between individuals at the micro level give rise to some patterns at the macro level such as social structures and organizations.

When applying complexity theory to social phenomena it should be taken into account that humans have the ability to recognize and interact with macro-level entities (institutions for example) which they have created themselves through their interactions. Gilbert and Troitzsch (2005:12) called this reflexive action ‘second-order
emergence', and argue that it is one of the characteristics distinguishing human societies from animal societies.

5.9 Justification for Using ABM in the Current Thesis

ABM is a suitable method for the current research for the following reasons:

- The main focus of the current research is a complex and emerging phenomenon, that is, the co-emergence of social and workplace segregation.
- And the main objective of the research is to understand the underlying causal mechanisms of segregation, and how the interactions and preferences of individuals at the micro level produce the observed macro level of segregation, with no direct interest in predicting the level of workplace and social segregation based on religion in Egypt (if it is predictable in the first place).

These reasons suggest and support the choice of ABM as an investigation tool for the current thesis.

5.10 Schelling Model of Residential Segregation

Schelling's (1971) seminal model of residential segregation is presented here as a good example of social simulation that describes an emerging phenomenon based upon simple local social interaction. In addition, it is relevant to the main topic of the current thesis, that is, segregation. Schelling was interested in the phenomenon of racial residential segregation in American cities, and he aimed to explain how segregation could happen, and how these segregationist residential structures, such as ghettos, may occur spontaneously, even if people are relatively tolerant towards others of different ethnic groups, and even when they are happy with being a minority in their neighbourhoods.
To build his simulation model, Schelling used the squares on a checkerboard to represent dwellings and differently coloured coins to represent people (agents). He started with a fully integrated society by randomly distributing the coins over the board. To define the model's dynamics, Schelling supposed that people have a 'threshold of tolerance' of other ethnic groups. That means that people (or coins) are content to stay at their Moore neighbourhood (which consists of the eight cells to the north, north-east, east, south-east, south, south-west, west and north-west) as long as the proportion of their neighbours of the same ethnic group as themselves is not less than this threshold. For example, with 50 percent threshold of tolerance, people would be happy to stay as long as at least four out of eight of their neighbours are from the same ethnic group; otherwise, they try to move to another neighbourhood satisfying this proportion.

Schelling ran a series of simulation experiments that were organized around different assumptions, with different levels of threshold. In one experiment, for example, he supposed that a person would move to an open square if just one current neighbour were from a different race (100 percent threshold). The result, as would be easily predicted, was light and dark coins segregated quickly.

A second experiment was subtler, where Schelling supposed that a person would not want to be part of an extreme racial minority. In this simulation, coins move only when they found themselves alone among unlike coins. In short order, sharp divides among neighbourhoods began to emerge. The effect was so pronounced and persistent that Schelling concluded that even if all traces of racism could somehow be obliterated, segregation could still happen.

Although Schelling's computational tools (the checkerboard and coins) were not so advanced, his model can be easily developed into a computerized model. A Cellular Automata, CA, version of the model is included in the model library of NetLogo.
software (Wilensky 1997). In this model, a cell (or dwelling) can be in any of three colours: white, black, or grey when it is occupied by a white agent, occupied by a black agent, or is empty respectively. For each simulated time step, each agent is examined to see whether it is content, that is, whether the number of neighbours of the same colour is at least equal to its tolerance threshold. If an agent is content, it would stay at its position for the next time step, otherwise, it searches for a nearby unoccupied cell which has the desired proportion of similar neighbours, and if this cell is found, the agent moves to it, otherwise stays at its cell. The simulation continues until all agents are content, or a certain number of time steps has passed.

Figure 5.3: The result of the simulation of Schelling model.
Figure 5.3 shows the result of the simulation with 2000 agents. The upper-left panel of the figure shows the starting random allocation of black and white agents over the grid, and then other three panels show the final configurations after running the simulation with tolerance thresholds of 37.5 percent (at least three of an agent’s eight neighbours must be of the same colour for the agent to be content), 50 percent (four out of eight), and 75 percent (six out of eight). Clustering emerges even when agents are happy to be a minority in their neighbourhood (with 37.5 percent threshold), and the sizes of those emergent clusters increase with increasing levels of tolerance threshold.

5.11 Chapter Conclusion

In this chapter, social simulation has been discussed as a research method. The chapter started with defining social simulation, discussing the typical objective of simulation research which is the understanding of the underlying dynamics of complex systems. Then it discussed using simulation as a modelling method and the analogy between simulation and mathematical and statistical modelling emphasising the advantages of each modelling method.

The epistemologies of social simulation were briefly discussed, and simulation was identified as a third way of doing science, in addition to induction and deduction. Also complex systems (the broad category of most social systems) were defined and their characteristics are discussed. Then, the chapter focussed specifically on ABSS. It discussed the historical origins and the evolution of ABSS within DAI, and the main concept associated with it; which is emergence. A justification is provided for using ABM as a research tool for the current thesis due to the complexity of the topic and the research objectives. Finally, the Shelling’s model of segregation has been introduced as a good and relevant example of social simulation.

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6 METHODOLOGY

6.1 Aims of This Chapter

As stated in earlier chapters, this thesis aims to develop an agent-based simulation model that describes the co-emergence of social and workplace segregation. In the previous chapter, agent-based social simulation has been introduced as a research method, and a justification has been provided for its suitability for the current research. This chapter discusses data requirements to build such a model and how these data were obtained.

Section 6.2 identifies the three data sources used in the current thesis, and then each of these sources is discussed in a separate section: the Social Contract Survey in Section 6.3, the Workers' Status in Industrial Enterprises Survey in Section 6.4, and the primary data (including interviews with a sample of workers and employers) in Section 6.5. The questionnaires, employer questionnaire and worker questionnaire used to collect the primary data, are presented in Section 6.6. Finally, the programming language used to build the simulation model is presented in Section 6.7.

6.2 Data Sources

Three data sources have been used in an integrated way to provide the information about social networks and workplaces within the Egyptian context. Two of these sources are secondary data from nationwide surveys: the Social Contract Survey (SCS) and Workers' Status in Industrial Enterprises Survey (WSIES), while the third
source involves structured interviews with a sample of workers and employers. In the following, a brief description of these sources is presented.

6.3 Social Contract Survey (SCS)

SCS was carried out by the Information and Decision Support Centre (IDSC), of the Egyptian Cabinet in 2005. This survey provides an assessment of the satisfaction of Egyptians about many public services such as social insurance, health services, education, electricity, water, transportation, etc. The survey also includes measures about political participation, trust in the economic performance of the country, and how far Egyptians feel safe and secure.

6.3.1 SCS Sample

As presented in Table 6.1, the SCS covered 17 of 26 Egyptian governorates, and it involved structured interviews with 6006 households.

SCS is one of the few surveys in Egypt that include data about the religion of individuals. The Identification sheet of the SCS survey included the variable “hhrel” which is the religion of the head of the household. All household members were assumed to follow the same religion as the head.
Table 6.1: Distribution of SCS sample.

<table>
<thead>
<tr>
<th>Governorate</th>
<th>Number of Households</th>
<th>Percent</th>
<th>Percentage of Copts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Governorates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1') Cairo</td>
<td>700</td>
<td>11.7</td>
<td>6.3</td>
</tr>
<tr>
<td>(2) Alexandria</td>
<td>399</td>
<td>6.6</td>
<td>2.0</td>
</tr>
<tr>
<td>(4) Suez</td>
<td>100</td>
<td>1.7</td>
<td>6.0</td>
</tr>
<tr>
<td>Lower Egypt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(11) Damitta</td>
<td>295</td>
<td>4.9</td>
<td>0.0</td>
</tr>
<tr>
<td>(13) Sharkia</td>
<td>292</td>
<td>4.9</td>
<td>2.7</td>
</tr>
<tr>
<td>(14) Qualubia</td>
<td>150</td>
<td>2.5</td>
<td>8.7</td>
</tr>
<tr>
<td>(15) Kafir El-Sheikh</td>
<td>292</td>
<td>4.9</td>
<td>0.7</td>
</tr>
<tr>
<td>(17) Menoufia</td>
<td>292</td>
<td>4.9</td>
<td>3.1</td>
</tr>
<tr>
<td>(18) Bohira</td>
<td>294</td>
<td>4.9</td>
<td>0.3</td>
</tr>
<tr>
<td>(19) Ismailia</td>
<td>292</td>
<td>4.9</td>
<td>3.1</td>
</tr>
<tr>
<td>Upper Egypt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(21) Giza</td>
<td>150</td>
<td>2.5</td>
<td>2.0</td>
</tr>
<tr>
<td>(22) Beni Suif</td>
<td>292</td>
<td>4.9</td>
<td>1.0</td>
</tr>
<tr>
<td>(23) Fayoum</td>
<td>291</td>
<td>4.8</td>
<td>9.3</td>
</tr>
<tr>
<td>(25) Assuit</td>
<td>541</td>
<td>9.0</td>
<td>12.2</td>
</tr>
<tr>
<td>(26) Sohag</td>
<td>793</td>
<td>13.2</td>
<td>4.8</td>
</tr>
<tr>
<td>(27) Qena</td>
<td>541</td>
<td>9.0</td>
<td>15.9</td>
</tr>
<tr>
<td>(28) Aswan</td>
<td>292</td>
<td>4.9</td>
<td>6.5</td>
</tr>
<tr>
<td>Total</td>
<td>6006</td>
<td>100.0</td>
<td>5.7</td>
</tr>
</tbody>
</table>

Source: based on data in (SCS 2005).
Governorate code (the variable gov) in the SCS data file.

6.3.2 Estimates from SCS

SCS data were used to estimate the overall proportion of Copts and unemployment rates. The overall proportion of Copts in Egypt has been controversial. Estimates range between 6 percent (according to formal published statistics) and 18 percent (according to estimates from the Church records) (Ibrahim 1996). The SCS data were used to estimate the overall proportion of Copts in Egypt and it was found to be very close to the official published statistics (around 6 percent).
Table 6.2: Unemployment rates for SCS and SCS using SCS data.

<table>
<thead>
<tr>
<th></th>
<th>Muslims</th>
<th>Copts</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working</td>
<td>86.9</td>
<td>92.1</td>
<td>97.1</td>
</tr>
<tr>
<td>Not working</td>
<td>13.1</td>
<td>7.9</td>
<td>12.9</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working</td>
<td>15.8</td>
<td>19.2</td>
<td>15.9</td>
</tr>
<tr>
<td>Not working</td>
<td>84.2</td>
<td>80.8</td>
<td>84.1</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Source: based on data in (SCS 2005).*

*Significant differences exist at 0.05 significance level.

Also, Table 6.1 shows that the distribution of Copts is not even among Egyptian governorates. Copts are concentrated in Upper Egypt more than in Lower Egypt and urban governorates. Also there is large variation among governorates in the same region. For example, although Beni Suif and Qena are both Upper-Egypt governorates, the percentage of Copts in them varies between one percent and around 16 percent respectively.

As presented in Table 6.2, SCS data were also used to estimate unemployment rates. The current thesis focuses only on male workers (no female workers were interviewed) because of the high level of unemployment among Egyptian females (around 84 percent) which makes the importance of workplaces as sources for social relations less important than males. As shown in the table, the overall unemployment rate for males is 12.9 percent, the unemployment rate for Muslims is 13.1 percent, and the unemployment rate for Copts is 7.9 percent. All the rates were calculated for individuals aged between 25 and 55 inclusive.
6.3.3 Sample Weights for SCS

Governorates are not proportionally presented in the SCS sample, so sample weights were needed to obtain correct overall estimates for the country. Table 6.3 shows the sample weights for each governorate in the SCS. For each governorate, its weight is defined to be its proportion in the population divided by its proportion in the sample. All estimates (proportion of Copts and unemployment rates) calculated from the SCS are based on weighted data.

Table 6.3: Sample weights for SCS Data.

<table>
<thead>
<tr>
<th>Governorate</th>
<th>Total Population (N)</th>
<th>Sample Size (n)</th>
<th>Sample Weight [(N/N) / (n/n)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cairo</td>
<td>6758581</td>
<td>2790</td>
<td>1.3445</td>
</tr>
<tr>
<td>Alexandria</td>
<td>4123889</td>
<td>1735</td>
<td>1.3192</td>
</tr>
<tr>
<td>Suez</td>
<td>512135</td>
<td>456</td>
<td>0.6234</td>
</tr>
<tr>
<td>Damitta</td>
<td>1097399</td>
<td>1139</td>
<td>0.5347</td>
</tr>
<tr>
<td>Sharkkia</td>
<td>5354041</td>
<td>1370</td>
<td>2.1691</td>
</tr>
<tr>
<td>Qualubia</td>
<td>4251672</td>
<td>677</td>
<td>3.4857</td>
</tr>
<tr>
<td>Kafr El-Sheikh</td>
<td>2620208</td>
<td>1323</td>
<td>1.0992</td>
</tr>
<tr>
<td>Menoufia</td>
<td>3270431</td>
<td>1242</td>
<td>1.4615</td>
</tr>
<tr>
<td>Behira</td>
<td>4747283</td>
<td>1536</td>
<td>1.7154</td>
</tr>
<tr>
<td>Ismailia</td>
<td>953006</td>
<td>1364</td>
<td>0.3678</td>
</tr>
<tr>
<td>Giza</td>
<td>3143486</td>
<td>624</td>
<td>2.7960</td>
</tr>
<tr>
<td>Beni Suf</td>
<td>2291618</td>
<td>1546</td>
<td>0.8227</td>
</tr>
<tr>
<td>Fayyum</td>
<td>2511027</td>
<td>1552</td>
<td>0.8080</td>
</tr>
<tr>
<td>Assuit</td>
<td>3444987</td>
<td>2878</td>
<td>0.6844</td>
</tr>
<tr>
<td>Sohag</td>
<td>3747289</td>
<td>4859</td>
<td>0.4280</td>
</tr>
<tr>
<td>Qena</td>
<td>3001681</td>
<td>2520</td>
<td>0.6811</td>
</tr>
<tr>
<td>Aswan</td>
<td>1188482</td>
<td>1814</td>
<td>0.3630</td>
</tr>
<tr>
<td>Total</td>
<td>(M) 53015115</td>
<td>(n) 29425</td>
<td></td>
</tr>
</tbody>
</table>
6.4 Workers' Status in Industrial Enterprises Survey (WSIES)

WSIES was carried out in June 2005 to assess the status of workers in industrial enterprises. An industrial establishment was defined to be any economic unit with the industrial activity representing 50 percent or more of its overall activity. The main objectives of the survey included the assessment of work conditions (for example, safety, availability of social insurance, transportation, nurseries and other non-pecuniary advantages) and the assessment of gender discrimination. The survey was a collaboration between the Ministry of Investment, the Social Research Centre (SRC) in the American University in Cairo, and the World Bank.

6.4.1 WSIES Sample

As presented in Table 6.4, the WSIES sample included structured questionnaires with 324 owners/managers of industrial enterprises in six governorates. The WSIES sample was distributed as follows:

Table 6.4: Distribution of WSIES sample.

<table>
<thead>
<tr>
<th>Governorate</th>
<th>Enterprises Number</th>
<th>Enterprises Percent</th>
<th>Male Workers Number</th>
<th>Male Workers Percent</th>
<th>Female Workers Number</th>
<th>Female Workers Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cairo</td>
<td>101</td>
<td>31.2</td>
<td>803</td>
<td>31.0</td>
<td>207</td>
<td>32.0</td>
</tr>
<tr>
<td>Alexandria</td>
<td>48</td>
<td>14.8</td>
<td>344</td>
<td>13.3</td>
<td>136</td>
<td>21.1</td>
</tr>
<tr>
<td>Sharqia</td>
<td>59</td>
<td>18.2</td>
<td>505</td>
<td>19.5</td>
<td>85</td>
<td>13.2</td>
</tr>
<tr>
<td>Qalyubia</td>
<td>43</td>
<td>13.3</td>
<td>354</td>
<td>13.6</td>
<td>76</td>
<td>11.8</td>
</tr>
<tr>
<td>Gharbela</td>
<td>32</td>
<td>9.9</td>
<td>236</td>
<td>9.1</td>
<td>84</td>
<td>13.0</td>
</tr>
<tr>
<td>Giza</td>
<td>41</td>
<td>12.7</td>
<td>352</td>
<td>13.6</td>
<td>58</td>
<td>9.0</td>
</tr>
<tr>
<td>Total</td>
<td>324</td>
<td>100</td>
<td>2594</td>
<td>100.0</td>
<td>646</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: based on data in WSIES (2005).
sample was selected as a subsample of the Investment Climate Survey (ICS) carried out by SRC and the World Bank during the period from October to December 2004 (the ICS sample included 1036 industrial enterprises from 16 governorates). The WSIES sample was selected as a representative sample for greater Cairo and Lower Egypt where most firms concentrate. The WSIES sample also included individual structured interviews with 2594 male workers and 646 female workers.

6.4.2 Estimates from WSIES

WSIES data were used to estimate the level of workplace segregation based on religion. Also, the data served as a frame to select employers and workers for further in-depth interviews (this will be explained later in the following section).

Although the raw data of the WSIES do not contain any information about workers’ religion, it was possible to infer it from their names. The interviewed manager of each sampled enterprises was asked to give a list of 10 to 15 complete names of workers for individual interview, and workers’ religions could be inferred from their names (or the names of their household members if the worker was selected for individual interview) in this list.

Most Egyptians have names that reflect their religious identity. For example, most Muslims have the name of prophet Mohamed (or one of his nicknames such as Ahmed, Mahmoud, Mostafa, and Taha) (47 percent of workers’ names), or one of his companions (for example Omar, Ali, and Osman) (23 percent of workers’ names) somewhere in their names: first, second, and/or third name. Also, many “Muslims-only” names include the word “Abdul” (for example, Abdul Rahman, Abdul Fattah, and Abdul Kareem) (29 percent of workers’ names). On the other hand, the most popular Coptic names include names such as Hannah, Bolis, Girgis, and Shenouda.
Table 6.5: Workplace segregation indices for WSIES sample.

<table>
<thead>
<tr>
<th>Firm size (Number of workers)</th>
<th>Gini Index (G)</th>
<th>Dissimilarity Index (D)</th>
<th>Number of Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-50</td>
<td>0.932</td>
<td>0.824</td>
<td>165</td>
</tr>
<tr>
<td>51-100</td>
<td>0.886</td>
<td>0.740</td>
<td>46</td>
</tr>
<tr>
<td>More than 100</td>
<td>0.831</td>
<td>0.711</td>
<td>113</td>
</tr>
<tr>
<td>Total</td>
<td>0.839</td>
<td>0.714</td>
<td>324</td>
</tr>
</tbody>
</table>

Source: based on data in WSIES (2005).

This procedure, of predicting a person’s religion his/her name, proved to be reliable within the Egyptian context. Workers’ religion recorded from the actual face-to-face interviews with the employers (Question 106 in the employer questionnaire in Appendix B) matched the predicted religion based on names in all cases.

Although the list given by firm’s manager does not include all workers in that firm, it was assumed to be a representative sample of workers within the firm, and hence reflects the distribution of workers by religion inside it. Table 6.5 presents the workplace segregation indices Gini and Dissimilarity Index for the WSIES data for various firm sizes.

6.5 The Primary Data

As presented in Table 6.6, the primary data involved structured face-to-face interviews with 39 employers (27 Muslim and 12 Coptic employers) and 122 workers (81 Muslim and 41 Coptic workers) in four Egyptian governorates during August and September 2007. Firms and workers have been selected as a subsample from the WSIES sample as explained in the following subsection.
Table 6.6: Distribution of firms and workers in the primary data.

<table>
<thead>
<tr>
<th>Governorate</th>
<th>Firms</th>
<th>Muslims</th>
<th>Copts</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Cairo</td>
<td>26</td>
<td>66.7</td>
<td>54</td>
<td>66.7</td>
</tr>
<tr>
<td>Alexandria</td>
<td>2</td>
<td>5.1</td>
<td>4</td>
<td>4.9</td>
</tr>
<tr>
<td>Sharkkia</td>
<td>2</td>
<td>5.1</td>
<td>5</td>
<td>6.2</td>
</tr>
<tr>
<td>Qualubia</td>
<td>9</td>
<td>23.1</td>
<td>18</td>
<td>22.2</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>100.0</td>
<td>81</td>
<td>100.0</td>
</tr>
</tbody>
</table>

6.5.1 Selection of Firms

To select the sample of firms for the current research 165 small\(^1\) firms with number of workers between 10 and 50 inclusive (from a total of 324 firms) were considered in the frame. There are two reasons for the current research to focus on this set of small firms rather than larger firms. Firstly, it would be hard for a firm with more than 50 workers to be thought as a single workplace where each worker interacts with all other workmates. Such firms are, most probably, divided into departments or sections where each could be considered as a workplace on its own. Secondly, it would be difficult to identify the employer or the person responsible for hiring decisions in firms.

\(^1\) According to the EU definition of micro, small, and medium enterprises; a small enterprise should include 10-49 employees. However, two enterprises with high Coptic percentage contained 50 employees, and it was thought to be useful to include them in the sample because of the low number of available firms with a high percentage of Copts.
with a very large number of workers; such firms usually have a separate department for human resources and follow rigorous hiring processes. Thus, it would be difficult to investigate some aspects of the demand side of labour (for example, hiring discrimination and statistical discrimination).

These 165 small firms are categorised according to the percentage of Coptic workers into three categories. The first category includes 133 firms with no Coptic workers (Predominantly Muslim firms). Half of remaining 32 firms with Coptic workers include less than 20 percent Copts (the second category: 16 Integrated firms) while the other half include 20 percent or more Copts (the third category: 16 Predominantly Coptic firms).

All firms from the second and the third categories were included in the sample for the current research (total 32 firms, 16 of each category). Besides, 16 firms were selected from the firms of the first category (Predominantly Muslim firms), with priority of selection given to firms in the nearest geographic area and with the closest number of workers to those firms selected from the other categories. The selection of firms in this way minimizes the effects of residential segregation by religion and firm size, and reduces the cost of travelling between distant sampling areas.

Table 6.7 summarizes the allocation of selected firms and the actual numbers interviewed in each category. Only 39 employers, out of 48, were interviewed. The remaining 9 were not interviewed for different reasons: five firms were closed, and four refused the interview without providing a reason.
Table 6.7: Planned and interviewed numbers of firms and workers.

<table>
<thead>
<tr>
<th>Firm Category</th>
<th>Firms P</th>
<th>Muslims P</th>
<th>Muslims I</th>
<th>Copts P</th>
<th>Copts I</th>
<th>Total P</th>
<th>Total I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predominantly Muslim</td>
<td>16</td>
<td>32</td>
<td>32</td>
<td>0</td>
<td>0</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Integrated</td>
<td>16</td>
<td>12</td>
<td>32</td>
<td>22</td>
<td>16</td>
<td>7</td>
<td>29</td>
</tr>
<tr>
<td>Predominantly Coptic</td>
<td>16</td>
<td>11</td>
<td>32</td>
<td>27</td>
<td>32</td>
<td>34</td>
<td>64</td>
</tr>
<tr>
<td>Total</td>
<td>48</td>
<td>39</td>
<td>96</td>
<td>81</td>
<td>48</td>
<td>41</td>
<td>144</td>
</tr>
</tbody>
</table>

P: Planned number
I: Interviewed number

6.5.2 Selection of Workers

122 most recently employed male workers were selected within the 39 interviewed firms. Only most recently hired workers were selected for interviews because the current research involves questions about work history that require recalling past experiences. For example, the respondents were asked how he got his current job, and how he had used his social network to facilitate the process of job search. It is also important to have some information about the experience of previous job(s). Interviewing recent workers would minimize the burden of recalling the past.

Only male workers were interviewed for two reasons. The first is that, according to the limited resources available for the research, the sample was not large enough to make separate analyses for male and female workers. The second reason is the sensitivity of interviewing female workers (especially at their homes), even by a female interviewer.
The sample of workers was planned as follows: two Muslim workers to be selected from predominantly Muslim firms (no Coptic workers in these firms), two Muslim workers and two Coptic workers to be selected from predominantly Coptic firms, and two Muslim workers and one Coptic worker to be selected from integrated firms.

However, some variations happened to this selection plan according to the availability of workers for interview or the cost of the interview (for workers living far from the firm and who were not available to be interviewed inside the firm). Also the religious composition of some firms had changed since the WSIES survey and it was not possible in some cases to find the required number of Coptic or Muslim workers for interview. More Coptic workers were interviewed, when possible, to compensate for their small number in the sample.

The sample size was chosen to provide an acceptable level of precision in the results with the limited resources available to the research. Table 6.7 summarizes the distribution of the planned and interviewed workers for different categories of firms.

6.5.3 Sample Weights for the Primary Data

Firm categories and workers of various religions are not proportionally represented in the sample of workers and employers. Copts and firms with a high Coptic proportion were oversampled. Hence, weights were used for estimates based on the sample at both worker level and firm level (although any generalization based on this small sample should be treated with caution). Table 6.8 shows how the sample weights were calculated for workers and firms. The weights were calculated using the formula: proportion in the population/proportion in the sample for each firm (for weights on the firm level), or for each combination of firm category and worker's religion (for weights on the worker level).
Table 6.8: Sample weights for the primary data.

<table>
<thead>
<tr>
<th>Firm Category</th>
<th>Copts (Total)</th>
<th>Copts (Sample)</th>
<th>Copts (Weight)</th>
<th>Muslims (Total)</th>
<th>Muslims (Sample)</th>
<th>Muslims (Weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predominantly Muslim</td>
<td>-</td>
<td>-</td>
<td>0.000</td>
<td>3229</td>
<td>39</td>
<td>2.419</td>
</tr>
<tr>
<td>Integrated</td>
<td>47</td>
<td>14</td>
<td>0.196</td>
<td>496</td>
<td>24</td>
<td>0.547</td>
</tr>
<tr>
<td>Predominantly Coptic</td>
<td>208</td>
<td>27</td>
<td>0.178</td>
<td>451</td>
<td>18</td>
<td>0.395</td>
</tr>
<tr>
<td>Total</td>
<td>254</td>
<td>41</td>
<td></td>
<td>4176</td>
<td>81</td>
<td></td>
</tr>
</tbody>
</table>

(B) Firms

<table>
<thead>
<tr>
<th>Firm Category</th>
<th>Total (Total)</th>
<th>Total (Sample)</th>
<th>Total (Weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predominantly Muslim</td>
<td>133</td>
<td>16</td>
<td>1.965</td>
</tr>
<tr>
<td>Integrated</td>
<td>16</td>
<td>12</td>
<td>0.315</td>
</tr>
<tr>
<td>Predominantly Coptic</td>
<td>16</td>
<td>11</td>
<td>0.344</td>
</tr>
<tr>
<td>Total</td>
<td>165</td>
<td>39</td>
<td></td>
</tr>
</tbody>
</table>

6.6 Questionnaires

Two types of questionnaires were used to collect the data for the current research: an employer questionnaire and a worker questionnaire; both are presented in detail in the following subsections. The questionnaires were translated from English into Arabic language, and all interviews were carried out in using the Arabic language.

6.6.1 Employer Questionnaire

The employer questionnaire (Appendix A) was used to gather data from owners/managers (who are responsible for recruiting decisions for new workers) of
the sampled firms about the religious composition of the firm, recruitment attitudes and practices, in addition to information about hiring and statistical discrimination. It was also essential in identifying potential workers for the workers’ interviews. The questionnaire includes three sections in addition to the cover page and the consent and identification page. The questionnaire was designed to be as short as possible, and it took 13 minutes on average to complete. Some details of the employer questionnaire are presented below.

**Cover Page**

The cover page contains the name and the date of the survey, and a clear statement that all data will be kept confidential and will be used for scientific research only.

**Consent Form**

"Informed consent" is a legal and moral right of the potential informant. It was defined by the US Department of Health, Education, and Welfare in 1974 as follows:

"Informed consent means the knowing consent of an individual or his legally authorized representative, so situated as to be able to exercise free power of choice without undue inducement or any element of force, fraud, deceit, duress, or any other form of constraint or coercion." (Singer 1993:361-362)

The consent form used in the current thesis was designed to comply with the definition and regulations developed by US Department of Health, Education, and Welfare. These regulations specify some elements of information necessary for informed consent (Singer 1993:362):

- A fair explanation of the procedures to be followed and their purposes.

The following statements in the introductory passage of the consent satisfy this requirement: "We are conducting this survey about employment, social
networks and religion... I would like to ask you about your experience and practices as an employer regarding recruiting new workers for your firm.

- **A description of discomforts and risks.** The only possible discomfort for the employer is to give some of his time to complete the survey: "The survey usually takes about 15 minutes to complete".

- **A description of benefits.** There is no direct personal benefit for the employer to complete the survey; however, it was clear that his participation is on a voluntary base.

- **An offer to answer any question:** "At this time, do you want to ask me anything about the survey?"

- **A statement that the person is free to withdraw at any time without prejudice:** "Participation in the survey is voluntary and you can choose not to answer any of the questions or withdraw from participation at any time."

**Identification Sheet**

The Identification Sheet provides data about the name and position of the respondent within the firm, the firm's name and address (including Governorate, Kism, and Shiakha\(^2\)), date and time of interview, and interviewer's name. It also informed the interviewer about the required number of Coptic and Muslim workers to be interviewed in the firm according to the sample allocation plan.

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\(^2\) Governorate, kism and shiakha are administrative divisions in Egypt comparable to county, town and area, respectively, in UK.
Section 1: Workers' Turnover

This section is the core part of the employer questionnaire. It provides information about the turnover of workers of different religion, and is used to identify workers for in-depth interviews. It includes data about some of the male workers that were working in the firm two years before the interview (at the time of WSIES interviews).

The identification number (Q100) and names of workers (Q101) were pre-filled from WSIES data. For each worker in this list, the employer was asked to give information about the worker's religion, whether he is still working in the firm or not. If the worker had left the firm, we ask why and when that happened. We also asked how long the worker has been (or "had been" in case he had left the firm) working in the firm. This information gave an overall picture of change of religious composition of firms, and exit patterns of workers of different religions.

Section 2: Selection of Workers for Interviews

This section provides brief background information about the religious composition of the firm in two different points in time: when the employer started his activity in the firm and at the time of interview. It also provides information about the most recent hired workers (and their religious affiliation) which helped in identifying workers for the workers interviews.

Section 3: Recruitment Attitudes and Practices

This section provides information about the recruitment methods usually used by the employer (Q301). Also, it provides some measures for statistical discrimination through a six-item question (Q302). Section 3 provides information about hiring discrimination through questions 303-306, and the perception of hiring discrimination exercised by Copts or Muslims against each other (questions 307-308), in addition to the respondent's perception of any discrimination against Copts as a minority group.
(questions 309 and 310). Finally, this section provides basic demographic information about the employer (for example, age, education level, and religion).

The questionnaire ends with recording time (to use along with start time to calculate average interview time) and degree of cooperation of respondent (how receptive was he/she to participating in the survey), thanking the respondent for participation, and recording any further notes or comments by interviewer.

### 6.6.2 Worker Questionnaire

The worker questionnaire (Appendix B) was designed to provide information about how people use their social networks to find jobs, and how the ethnic/religious composition of social networks affects/changes with workplace segregation. The questionnaire provides information about the religious composition and the structure of worker's social network, job history, sources and the flow of information about job vacancies, in addition to information about the religious tolerance of respondents. The worker questionnaire includes four sections in addition to a cover page and consent and identification page.

The cover page and the consent/identification page are similar to those of the employer questionnaire with few modifications. Details of the other parts of the worker questionnaire are presented below.
Section 1: Background and Household Composition

This section provides basic background information on the respondent and his household members. This includes: name, relationship to respondent, sex, age, education, marital status, work status, and whether the household member works in the same line of work as the respondent or not. The household composition provided valuable information about an important part of respondent's social network, that is, the adults living in the same household with him (Grossetti 2005).

Section 2: Respondent’s Social Network

The definition of the size of social network, "the number all alters that ego has relations with" (Marsden 1987:232), is too wide to use for empirical surveys. Most people have relations (of different kinds and strength) with hundreds of other people (Hill & Dunbar 2003). According to Wellman (1990), most people have about 400 actual ties. So, the definition of social network has to be operationalized according to the research objectives (McCallister & Fischer 1983). The current research focuses on this part of respondents' social networks that most influence their attitudes, behaviour, and well-being. McCallister and Fischer call this part the “core” network, and they defined it as:

"...the set of people who are most likely to be sources of a variety of rewarding interactions, such as discussing a personal problem, borrowing money, or social recreation" (McCallister & Fischer 1983:78).

3 Household is defined as a group of people who usually live, eat, and sleep together in the same housing unit even if they are not relatives.
This section provides information about the composition and structure of respondent's "core" social network. The method used to obtain information about respondent's social network relies on the same strategy of name generators as used by McCallister and Fischer (1983) in their Northern California Community Study (NCCS) of the personal consequences of residential environment. This strategy involves asking the respondents to name people with whom they were likely to have valued interactions. The questions from 201 to 206 and 208 include the name generators that have been suggested by McCallister and Fischer (1983), and include:

Q201, discuss important matters: "From time to time, most people discuss important matters with other people. Who are the people with whom you discuss matters important to you?"

Q202, help with major household tasks: "Who from outside your household has recently helped you with tasks around the home, such as painting, moving furniture, cooking, cleaning or major or minor repairs?"

Q203, borrow minor things: "Suppose you need to borrow some small thing such as a tool or a cup of sugar, from whom outside your household would you ask to borrow it?"

Q204, borrow large sum of money: "If you need to borrow a large sum of money, say LE1000, whom would you ask for help?"

Q205, socializing and entertainment: "Who are the people you really enjoy socializing with? For example, people with whom you may have lunch or dinner together, you may exchange home visits, or you may meet outside the home for recreation (e.g. restaurant, coffee shop, park, club, etc.)."
Q206, talk about work matters: "With whom would you talk about your work? For example, decisions you have to make, professional problems you have to solve and ways to improve how you work?"

Q208, any unmentioned important persons: "Are there any other persons that are close to you that have not been mentioned in one of the previous questions?"

These name generators cover wide sources of relationships: intimate and close friends, neighbours, relatives, etc. For the objectives of current research, an additional name generator was used in the worker questionnaire, which is question 207: "If you are going to search for a new job, whom would you ask for information or help?" This question provides information about the flow of job information through social networks.

The second step, after having a list of the respondent's core network alters (questions 209 and 210), was to ask detailed questions about these people. The questions from 211 to 221 provide details about sex, origin of relation, religion, marital status, etc. Question 221 provides information about respondent's network density - the mean strength of connection among alters, or the proportion of links present relative to those possible (Marsden 1990). Unlike most studies, such as McCallister & Fischer (1983) and Marsden (1987), that ask about the relation among a subsample of alters (since it is not usually possible to get this information for all pairs of alters), I asked here about a sample of relation among all alters. In question 221, the respondent was asked to evaluate the relationship between each person in the table with the preceding person (the first person is matched with the last one). This technique helps reducing the questionnaire space since it does not require a separate section to ask about network density. It reduces the interviewer's burden since he will not need to select a subsample of alters to ask about their relationship.
Section 3: Work History

This section provides information about how people use their social networks to find information about jobs, and the level of segregation of the workplaces they had worked in. The Work History section includes information about the respondent’s last three jobs (including the current one). For each job we ask about: job title and category, date of start working in this job and date of leaving it (if applicable), how far is/was the job from respondent's house.

A number of questions are included about the source of job information and the contact person: his relationship to respondent, religion, how did he know about the job, and whether he has worked with the respondent before. The section also includes some questions about job satisfaction and the relationship between respondent and his employer and workmates, the religious affiliation of workers, and finally why the respondent had left the job.

Section 4: Attitudes towards Others of Different Religion

This section provides information about the respondent's attitudes towards working with employers and other workmates of different religion, his perception of any discrimination against the Coptic minority, and whether Coptic or Muslim employers discriminate against workers of different religion to their own.

For example, questions 401 and 403 describe the respondent's attitude towards working with an employer or workmates of a different religion. The questions 405-411 are similar to the questions in the employer questionnaire, and they provide measures for statistical discrimination and stereotyping perceived by the worker, information about hiring discrimination in the firm, and the perception of hiring discrimination exercised by Copts or Muslims against each other, in addition to the respondent's perception of any discrimination against Copts as a minority group.
Like the Employer questionnaire, the worker questionnaire ends with recording time, thanking the respondent, and recording any notes or comments by the interviewer.

### 6.6.3 Fieldwork

Due to the number of interviews and time limitation on the fieldwork, two professional interviewers were recruited and trained to help in the data collection process. Employers were called (whenever their phone numbers are available in the database; otherwise, the researcher visited them directly), informed about the study and asked to participate in it. All employers’ interviews took place in their firms. With employers’ permissions, workers were offered to have their interviews in their homes or in the firms, and most workers’ interviews were in the firms (112 of 122 interviews).

### 6.6.4 Office Work

All questionnaires were reviewed for completeness and consistency. Then, a codebook was developed to post-code open-ended questions and questions that included “Other” answers.

A data entry program was developed using Microsoft Access, and data were entered into the computer. Regular verification checks were performed, and then data were converted to SPSS (Statistical Package for Social Sciences) files for statistical analysis.
6.7 Programming

The simulation model was developed using NetLogo4 (version 4.0.3). NetLogo is a multi-agent programmable modelling environment. It was developed by Uri Wilensky in 1999 at the Centre for Connected Learning (CCL) at Northwestern University, USA. NetLogo inherits some aspects of the Logo programming language; for example, the main agents are “turtles” moving around “patches” (Gilbert & Troitzsch 2005).

NetLogo was selected as a programming tool for many reasons. It is a simple and easy to use yet powerful programming language; with a single line of code, one can ask NetLogo to perform many complicated tasks. NetLogo is an object-oriented programming language, perfectly suited for agent-based models. Another reason for choosing NetLogo is that it can be easily used for creating models involving social networks using its predefined Link agent set that (as apparent from the name) can link two agents together.

6.8 Chapter Conclusion

This chapter presented the three data sources that have been used to provide the information needed to build and validate the model of social and workplace segregation. Two of these sources are secondary data from the Social Contract Survey (SCS) and Workers’ Status in Industrial Enterprises Survey (WSIES), while the third source is primary data involving structured interviews with a sample of workers (122) and employers (39).

4 NetLogo is available for download for free at: http://ccl.northwestern.edu/netlogo
The chapter also introduced two types of questionnaires that have been used to collect the primary data: the employer questionnaire and the worker questionnaire, and discussed some issues regarding the office work and the preparation of the data for statistical analysis, for example, coding and data entry, in addition to introducing the programming language used to implement the simulation model.
7 STATISTICAL ANALYSIS OF THE PRIMARY DATA

7.1 Aims of This Chapter

In this chapter, the main findings of the empirical primary data are presented and discussed. In the Section 7.2, an overview of the main findings is introduced. The results of the analysis of the Employers Questionnaires are presented in Section 7.3, these include: firms' background, workers' turnover, hiring practices, stereotyping and statistical discrimination, and hiring discrimination, and employers' background characteristics.

The results from the Workers Questionnaires are discussed in Section 7.4, these include: workers' background characteristics, workers' social networks, job search and job contacts, workers' turnover, work preferences, and workers' perception of hiring discrimination and stereotyping.

7.2 Introduction

The main findings from the employers' and workers' data shed some light on social networks and social integration between Muslims and Copts in the Egyptian society. The results focus on the processes of workers' recruitment and job search methods within the Egyptian labour market for both Muslim and Coptic workers and employers, and how these affect workplace segregation based on religion.

The statistical analysis of the employers' interviews shows that most employers rely on informal methods for recruiting workers, and the recruitment through insider
referrals is very common. There was no direct evidence for hiring or statistical discrimination based on employers' responses. However, there is a strong relationship between an employer's religion and the religious affiliation of his workers.

The workers' data show that Muslims and Copts have social networks of similar structure and size. However, social networks for both Muslims and Copts tend be religiously homophilous. Consequently, Muslims and Copts usually have job information from people of the same religion. The data also show that Copts tend, more than Muslims, to work in segregated workplaces based on religion. Moreover, the duration that a Coptic worker stays in employment at a workplace was found to be correlated to the percentage of Copts in this workplace.

The following provides more detail about these results.

7.3 Analysis of Employers Data

The Employer questionnaire took on average 13 minutes to complete with the owner or manager of the firm. Most employers (33 of 39) were receptive to participation in the survey. Some (6 employers), however, were not comfortable with discussing these sensitive issues about Copts-Muslims relations at work. A summary of the results from the employer questionnaire is given in the following.

7.3.1 Firms' Background

Table 7.1 presents the distribution of the sampled firms according to some background characteristics for each firm category. As defined in Chapter 6, predominately Muslim firms are those firms with no Copts at all, integrated firms have some Copts but less than 20 percent, while predominately Coptic firms are those with more than 20 percent Copts.
The firm categories used throughout this chapter are based on data from the Employer's Questionnaire: question 204; number of current workers in the firm, and question 205; number of current Coptic workers in the firm, rather than estimated ones based on data from WSIES (see Selection of Firms in Chapter 6 for more details). The proportion of Copts in the same firm may have changed from the time of WSIES (2005) to the time of the interview due to workers' movement in and out the firms.

Table 7.1: Firms' background characteristics.

<table>
<thead>
<tr>
<th>Firm category</th>
<th>Predominately Muslim</th>
<th>Predominately Integrated</th>
<th>Predominately Coptic</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Governorate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cairo</td>
<td>12</td>
<td>6</td>
<td>8</td>
<td>26</td>
</tr>
<tr>
<td>Alexandria</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Sharkkia</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Qualubia</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Firm's age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 10 years</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>10-19</td>
<td>6</td>
<td>5</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>20-29</td>
<td>6</td>
<td>1</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>30-39</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>40 and more years</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Mean age</td>
<td>18.8</td>
<td>17.4</td>
<td>30.0</td>
<td>21.5</td>
</tr>
<tr>
<td>Number of workers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-19</td>
<td>8</td>
<td>5</td>
<td>6</td>
<td>19</td>
</tr>
<tr>
<td>20-29</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>30-39</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>40-50</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Mean size</td>
<td>24</td>
<td>29</td>
<td>21</td>
<td>25</td>
</tr>
<tr>
<td>Total number</td>
<td>16</td>
<td>12</td>
<td>11</td>
<td>39</td>
</tr>
</tbody>
</table>

Source: employer data.
As shown in Table 7.1, the sampled firms were selected from four governorates: Cairo, Alexandria, Sharkkia, and Qualubia (the majority were from Cairo; 26 firms, and Alexandria; 9 firms). The mean age of the firm was 22 years. The firms vary widely, in terms of age, from 2 to 67 years old. Table 7.1 shows that the number of workers in these firms varies between 10 and 50, with a mean of 25 workers, and around half of the firms employ less than 20 workers.

### 7.3.2 Workers’ Turnover

As explained earlier in Chapter 3, the exit patterns of workers may affect workplace segregation (Sørensen 2004). Firms may recruit their workers using formal methods based on equal opportunity practices, and may start with all social groups proportionately represented in the firm, yet segregation may happen due to the exit patterns of workers and their responses to changes of the religious, ethnic, or racial composition of their workplaces. This may happen when workers tend to stay longer in workplaces where their own social group is overrepresented compared with other workplaces.

<table>
<thead>
<tr>
<th>Firm category</th>
<th>Mean job duration (months)</th>
<th>Number of workers</th>
<th>Source: employer data.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predominately Muslim</td>
<td>103.5</td>
<td>323</td>
<td></td>
</tr>
<tr>
<td>Integrated</td>
<td>107.5</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>Predominately Coptic</td>
<td>130.9</td>
<td>141.2</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>105.2</td>
<td>141.2</td>
<td></td>
</tr>
<tr>
<td>Number of workers</td>
<td>323</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>399</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7.2: Mean job duration (in months) for Muslim and Coptic workers.
As presented in Table 7.2, the overall mean job duration for all workers was around 9 years (107.4 months) (job duration is calculated from question 103 and 105 of the employer questionnaire). The mean job duration for Muslim workers was about 105 months, and there is no significant difference in this mean according to percentage of Copts in the workplace. For Coptic workers, the mean job duration was higher (about 141 months); however, the difference in job duration between Copts and Muslims is not statistically significant, and there is also no significant difference in this mean by percentage of Copts in the workplace.

There is no clear evidence, based on the data presented in Table 7.2, that Copts or Muslims prefer to stay longer where they are overrepresented. However, this hypothesis will be tested again later in this chapter using data from the worker questionnaire where job duration is reported by the workers themselves which makes it more likely to be accurate, and the test will be based on a larger sample.

Table 7.3: Reasons for workers to leave their workplaces.

<table>
<thead>
<tr>
<th>Reasons (Q104)</th>
<th>Muslim Workers</th>
<th>Coptic Workers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Found another job</td>
<td>50.6</td>
<td>43.8</td>
<td>49.5</td>
</tr>
<tr>
<td>Was not happy with salary</td>
<td>5.7</td>
<td>12.5</td>
<td>6.8</td>
</tr>
<tr>
<td>Was not good at job</td>
<td>4.6</td>
<td>0.0</td>
<td>3.9</td>
</tr>
<tr>
<td>His behaviour was not good</td>
<td>1.1</td>
<td>6.3</td>
<td>1.9</td>
</tr>
<tr>
<td>No longer needed</td>
<td>5.7</td>
<td>0.0</td>
<td>4.9</td>
</tr>
<tr>
<td>Went to the army</td>
<td>11.5</td>
<td>6.3</td>
<td>10.7</td>
</tr>
<tr>
<td>Dead/Sick</td>
<td>8.0</td>
<td>25.0</td>
<td>10.7</td>
</tr>
<tr>
<td>Other</td>
<td>12.8</td>
<td>6.1</td>
<td>11.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0</strong></td>
<td><strong>100.0</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Source: employer data.
7.3.3 Main Reasons for Workers to Leave Their Workplaces

For those workers who had left their workplaces between the time of WSIES and the interview, employers were asked about the reasons for them leaving (question 104). Table 7.3 summarizes the results. Half the workers left because they had found another job, and some were not happy with the salary (around 7 percent), or joined the army. No significant differences found between Copts and Muslims regarding the reason to leave.

7.3.4 Employers’ Background

The employer questionnaire included two background questions about employers’ age (based on Q311) and education (Q312). As shown in Table 7.4, the mean age of employers was around 52 years, and around four fifth of them have a university or higher degree of education.

Table 7.4: Percent distribution of employers by background characteristics.

<table>
<thead>
<tr>
<th>Age (Q311)</th>
<th>Muslim Employers</th>
<th>Coptic Employers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-39</td>
<td>14.8</td>
<td>25.0</td>
<td>17.9</td>
</tr>
<tr>
<td>40-49</td>
<td>29.6</td>
<td>8.3</td>
<td>23.1</td>
</tr>
<tr>
<td>50-59</td>
<td>33.3</td>
<td>41.7</td>
<td>35.9</td>
</tr>
<tr>
<td>60-69</td>
<td>11.1</td>
<td>16.7</td>
<td>12.8</td>
</tr>
<tr>
<td>70+</td>
<td>11.1</td>
<td>8.3</td>
<td>10.3</td>
</tr>
<tr>
<td>Mean age</td>
<td>51.2</td>
<td>52.4</td>
<td>51.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Educational level (Q312)</th>
<th>Muslim Employers</th>
<th>Coptic Employers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>7.4</td>
<td>8.3</td>
<td>7.7</td>
</tr>
<tr>
<td>Secondary</td>
<td>14.8</td>
<td>8.3</td>
<td>12.8</td>
</tr>
<tr>
<td>University/Higher</td>
<td>77.8</td>
<td>83.3</td>
<td>79.5</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Number of employers: 27 12 39

Source: employer data.
7.3.5 Hiring Practices

The employer questionnaire includes information about how frequently employers use each of the recruiting methods (Question 301):

- Formal methods, through advertisement and/or employment agency
- Through current workers, that is, using insider referrals
- Through employer's social network, that is, employer's friends and relatives
- Old workers, or someone eligible known to the employer
- Any other recruiting methods, for example, Labour Office or a worker may pass and ask for a job.

Table 7.5 presents the number and percentage of employers who reported that they frequently or sometimes use each of these recruiting methods. Using informal methods to hire new workers is a very common practice in the sampled firms. For example, about 81 percent of employers hire new workers through referrals from the current workers in their firms (and this may have a large effect on the level of

Table 7.5: Hiring methods reported by employers

<table>
<thead>
<tr>
<th>Hiring Method (Q301)</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formal channels (Advertisement/Employment agency)</td>
<td>20</td>
<td>51.0</td>
</tr>
<tr>
<td>Through current workers</td>
<td>31</td>
<td>80.5</td>
</tr>
<tr>
<td>Through employer's friends/relatives</td>
<td>19</td>
<td>47.5</td>
</tr>
<tr>
<td>Old workers or someone known to the employer</td>
<td>22</td>
<td>55.6</td>
</tr>
<tr>
<td>Other methods</td>
<td>5</td>
<td>13.9</td>
</tr>
<tr>
<td><strong>Number of employers</strong></td>
<td>39</td>
<td></td>
</tr>
</tbody>
</table>

*Source: employer data.*
workplace segregation). On the other hand, formal recruiting channels, through advertisements and employment agencies are used by around half of the employers. No significant differences were found by religion of the employers or by proportion of the Copts in the firm (not presented in the table).

7.3.6 Stereotyping and Statistical Discrimination

The employers were asked a set of questions (Q302) in the form: Which workers, Copts or Muslims, do you think work harder, are more honest, are more cooperative with managers/supervisors, etc. As presented in Table 7.6, there is an indication that only Muslim employers practice stereotyping and statistical discrimination. All Coptic employers reported that Muslim and Coptic workers are “the same” in all questions. However, more than one fifth of the Muslim employers believe that Muslim workers are more honest, more cooperative with other workmates, and more cooperative with their managers and supervisors, while around 17 percent of them believe that Coptic workers are more respectful to work rules.

These results from the employer's interviews should be treated as a general indication rather than solid evidence of stereotyping and statistical discrimination. Firstly, the sample size does not allow for solid generalizations, especially with Coptic employers (only 12 interviews). Secondly, there is a possibility that the results may be biased because people from minority groups generally tend to give more socially desirable answers than majority group people.
Table 7.6: Stereotyping and statistical discrimination of employers

<table>
<thead>
<tr>
<th>Q302: Which workers, Coptic or Muslim, do you think are better than the other in each of the following:</th>
<th>Muslim Employers</th>
<th>Coptic Employers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work harder</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>13.9</td>
<td>0.0</td>
<td>12.8</td>
</tr>
<tr>
<td>Copts</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>The same</td>
<td>86.1</td>
<td>100.0</td>
<td>87.2</td>
</tr>
<tr>
<td>More honest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>22.2</td>
<td>0.0</td>
<td>20.5</td>
</tr>
<tr>
<td>Copts</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>The same</td>
<td>77.8</td>
<td>100.0</td>
<td>79.5</td>
</tr>
<tr>
<td>More cooperative with managers/supervisors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>22.2</td>
<td>0.0</td>
<td>20.5</td>
</tr>
<tr>
<td>Copts</td>
<td>2.8</td>
<td>0.0</td>
<td>2.6</td>
</tr>
<tr>
<td>The same</td>
<td>75.0</td>
<td>100.0</td>
<td>76.9</td>
</tr>
<tr>
<td>More cooperative with other workmates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>22.2</td>
<td>0.0</td>
<td>20.5</td>
</tr>
<tr>
<td>Copts</td>
<td>2.8</td>
<td>0.0</td>
<td>2.6</td>
</tr>
<tr>
<td>The same</td>
<td>75.0</td>
<td>100.0</td>
<td>76.9</td>
</tr>
<tr>
<td>Respect work rules</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>8.3</td>
<td>0.0</td>
<td>7.7</td>
</tr>
<tr>
<td>Copts</td>
<td>16.7</td>
<td>0.0</td>
<td>15.4</td>
</tr>
<tr>
<td>The same</td>
<td>75.0</td>
<td>100.0</td>
<td>76.9</td>
</tr>
<tr>
<td>Accept lower salary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>5.7</td>
<td>0.0</td>
<td>5.3</td>
</tr>
<tr>
<td>Copts</td>
<td>5.7</td>
<td>0.0</td>
<td>5.3</td>
</tr>
<tr>
<td>The same</td>
<td>88.6</td>
<td>100.0</td>
<td>89.5</td>
</tr>
<tr>
<td>Number of Employers</td>
<td>27</td>
<td>12</td>
<td>39</td>
</tr>
</tbody>
</table>

Source: employer data.
7.3.7 Hiring Discrimination

The employers were asked a set of questions to assess their hiring discrimination (question 303-310). Table 7.7 summarizes the employers' responses to these questions.

None of Coptic employers reported that it is important to hire workers of the same religion as theirs (Q303), while around 17 percent of Muslim employers reported it is important. The three main reasons given by the Muslim employers for their preference to have Muslim workers only were (not shown in the table):

- "To practice religious activities (e.g., to pray, fast, celebrate feasts) together"
- "To have the same morals and attitudes"
- "Do not like to deal with people from other religion"

To assess the perception of the employers regarding any potential problems, or benefits, of having Copts and Muslims working in the same workplace, employers were asked: "How good or bad thing, you think, is it to have workers with different religions in the same workplace?" (Q305). The majority of employers were neutral, that is, they reported that it is neither good nor bad to have workers of different religions together at the same workplace; one fifth of Muslim and half Coptic employers reported it is good, and about 14 percent of Muslim employers said it is bad. Benefits reported for having Copts and Muslims together in the same workplace include (Q306):

- "Would spread love and friendship among people"
- "Decreases the sensitivity between Copts and Muslims"
- "Help exchanging ideas and experiences"
- "Create environment with good competition"
- "They [Copts and Muslims] have different vacations in feasts, so, there will be workers to run the business all the time"

- "Help stopping discrimination against Copts and Muslims in the work"

- "Help presenting a good picture of the Egyptian society with no discrimination"

Table 7.7: Employers' responses to questions about hiring discrimination.

<table>
<thead>
<tr>
<th>Question</th>
<th>Muslim Workers</th>
<th>Coptic Workers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q303: Is it important or not important to have workers of the same religion as yours?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important</td>
<td>16.7</td>
<td>0.0</td>
<td>15.4</td>
</tr>
<tr>
<td>Not important</td>
<td>83.3</td>
<td>100</td>
<td>85.0</td>
</tr>
<tr>
<td>Q305: Is it good or bad to have workers with different religions in the same workplace?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>19.4</td>
<td>50.0</td>
<td>22.5</td>
</tr>
<tr>
<td>Bad</td>
<td>13.9</td>
<td>0.0</td>
<td>12.5</td>
</tr>
<tr>
<td>Neutral</td>
<td>66.7</td>
<td>50.0</td>
<td>65.0</td>
</tr>
<tr>
<td>Q307: Do you agree or disagree that Muslims tend to employ each others more than employing Copts?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agree</td>
<td>25.0</td>
<td>33.3</td>
<td>25.6</td>
</tr>
<tr>
<td>Disagree</td>
<td>72.2</td>
<td>33.3</td>
<td>69.2</td>
</tr>
<tr>
<td>Neutral</td>
<td>2.8</td>
<td>33.3</td>
<td>5.1</td>
</tr>
<tr>
<td>Q308: Do you agree or disagree that Copts tend to employ each others more than employing Muslims?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agree</td>
<td>55.6</td>
<td>33.3</td>
<td>53.8</td>
</tr>
<tr>
<td>Disagree</td>
<td>36.1</td>
<td>33.3</td>
<td>35.9</td>
</tr>
<tr>
<td>Neutral</td>
<td>8.3</td>
<td>33.3</td>
<td>10.3</td>
</tr>
<tr>
<td>Q309: Do you agree or disagree that there is discrimination against Copts in Egypt?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agree</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Disagree</td>
<td>77.8</td>
<td>66.7</td>
<td>76.9</td>
</tr>
<tr>
<td>Neutral</td>
<td>22.2</td>
<td>33.3</td>
<td>23.1</td>
</tr>
<tr>
<td>Number of Employers</td>
<td>27</td>
<td>12</td>
<td>39</td>
</tr>
</tbody>
</table>

Source: employer data.
On the other hand, reasons given by employers against integrated workplaces include (Q306):

- "They have different habits, and this may create problems at the work"
- "I prefer not to recruit people from other religion at all"

To assess the perception of employers about the level of hiring discrimination in the Egyptian labour market, employers were asked: "How strongly do you agree or disagree that Copts/Muslims tend to employ each others more than employing Muslims/Copts?" (Q307 and Q308).

As presented in Table 7.7, more than half of Muslims employers believe that Coptic employers discriminate against Muslim workers, while only quarter of them reported that Muslim employers discriminate against Copts. For Coptic employers, one third of them think that there is a mutual discrimination between Muslims and Copts regarding employment.

Finally, none of the employers, Muslims or Copts, reported that they believe there is any discrimination against Copts in general in Egypt.

### 7.4 Analysis of Workers Data

The worker questionnaire took on average 22 minutes to complete. Most of the workers were happy to participate in the survey and complete the questionnaires. Like employers, however, there are 7 workers (5 Muslims and 2 Copts), representing around 6 percent of the sample, who did not show good level of cooperation and refused to answer some of the questions. In the following, a summary of the results from the worker questionnaire is presented.
7.4.1 Workers' Background

Table 7.8 presents the distribution of the interviewed workers by age (Q104) and educational level (Q105). Worker's age varied widely between 18 and 60 years, with a mean of about 37 years.

The majority of the workers, Copts and Muslims, have an educational level between primary and secondary, with around 10 percent who have never attended school at all, and 10 percent with a university degree. The mean number of years of education was 9.3 years for Coptic workers and 8.3 years for Muslims.

Some of the household characteristics are presented in Table 7.8. The mean household size (number of members) for Muslim workers (4.6) is slightly larger than for Copts (4.1). Around one quarter of household members are employed (in addition to the interviewed worker), and a small percentage (around 5 percent) of those are working in the same line of work as the respondent worker, that is, in the same workplace or in a similar job in another workplace.

7.4.2 Workers' Social Networks

As explained in detail in Chapter 5, the worker questionnaire included questions about the composition and structure of the worker's social network. A set of name generators (questions from 201 to 208) was used to elicit the names of alters, then, a number of detailed questions (questions 211 to 221), were asked about these alters. The worker's social network is defined to include all adults in his household in addition to the elicited ones. In the following, a summary of the results regarding the workers' network size and composition is presented.
Table 7.8: Percent distribution of workers by background characteristics.

<table>
<thead>
<tr>
<th>Age (Q104)</th>
<th>Muslim Workers</th>
<th>Coptic Workers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 30</td>
<td>22.8</td>
<td>28.6</td>
<td>23.1</td>
</tr>
<tr>
<td>30-39</td>
<td>39.5</td>
<td>28.6</td>
<td>38.8</td>
</tr>
<tr>
<td>40-49</td>
<td>30.7</td>
<td>14.3</td>
<td>29.8</td>
</tr>
<tr>
<td>50+</td>
<td>7.0</td>
<td>28.6</td>
<td>8.3</td>
</tr>
<tr>
<td>Mean age</td>
<td>36.7</td>
<td>39.2</td>
<td>36.9</td>
</tr>
</tbody>
</table>

Educational level (Q106)

<table>
<thead>
<tr>
<th></th>
<th>Muslim Workers</th>
<th>Coptic Workers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No education at all</td>
<td>11.4</td>
<td>14.3</td>
<td>11.6</td>
</tr>
<tr>
<td>Primary</td>
<td>29.8</td>
<td>14.3</td>
<td>28.9</td>
</tr>
<tr>
<td>Preparatory</td>
<td>14.9</td>
<td>14.3</td>
<td>14.9</td>
</tr>
<tr>
<td>Secondary</td>
<td>33.3</td>
<td>42.9</td>
<td>33.9</td>
</tr>
<tr>
<td>University/Higher</td>
<td>10.5</td>
<td>14.3</td>
<td>10.7</td>
</tr>
<tr>
<td>Mean years of education</td>
<td>8.3</td>
<td>9.3</td>
<td>8.3</td>
</tr>
<tr>
<td>Mean number of household members</td>
<td>4.6</td>
<td>4.1</td>
<td>4.6</td>
</tr>
</tbody>
</table>

Work status for household members (Q108)

<table>
<thead>
<tr>
<th></th>
<th>Muslim Workers</th>
<th>Coptic Workers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working</td>
<td>24.0</td>
<td>26.7</td>
<td>24.2</td>
</tr>
<tr>
<td>Not working</td>
<td>76.0</td>
<td>73.3</td>
<td>75.8</td>
</tr>
</tbody>
</table>

Type of work (Q109)

<table>
<thead>
<tr>
<th></th>
<th>Muslim Workers</th>
<th>Coptic Workers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>The same as worker's</td>
<td>5.0</td>
<td>0.0</td>
<td>4.6</td>
</tr>
<tr>
<td>Different from worker's</td>
<td>95.0</td>
<td>100.0</td>
<td>95.4</td>
</tr>
<tr>
<td>Total percentage</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Number of workers</td>
<td>81</td>
<td>41</td>
<td>122</td>
</tr>
</tbody>
</table>

Source: worker data.

7.4.2.1 **Network Size and Composition**

Table 7.9 summarizes the main findings of network size and composition for Coptic and Muslim workers. The average network size was 7.1 alters per worker, with a minimum of 2 and a maximum of 20. Mean network size for Copts (6.8) was slightly
Table 7.9: Size, average closeness of alters, religious affiliation of alters, and context of relation construction by worker's religion.

<table>
<thead>
<tr>
<th></th>
<th>Muslim Workers</th>
<th>Coptic Workers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Network size</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>7.1</td>
<td>6.8</td>
<td>7.1</td>
</tr>
<tr>
<td>Minimum</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Maximum</td>
<td>20</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td><strong>Strength of relation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intimate/Strong</td>
<td>96.9</td>
<td>96.1</td>
<td>96.9</td>
</tr>
<tr>
<td>Moderate</td>
<td>2.9</td>
<td>3.9</td>
<td>3.0</td>
</tr>
<tr>
<td>Weak</td>
<td>0.1</td>
<td>0.0</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Religion of alters</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>98.2</td>
<td>17.6</td>
<td>93.4</td>
</tr>
<tr>
<td>Copts</td>
<td>1.8</td>
<td>82.4</td>
<td>6.6</td>
</tr>
<tr>
<td><strong>Strength of relation among alters</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intimate/Strong</td>
<td>65.4</td>
<td>66.7</td>
<td>65.4</td>
</tr>
<tr>
<td>Moderate</td>
<td>5.0</td>
<td>6.3</td>
<td>5.1</td>
</tr>
<tr>
<td>Weak</td>
<td>1.8</td>
<td>2.1</td>
<td>1.8</td>
</tr>
<tr>
<td>No Relation</td>
<td>27.9</td>
<td>25.0</td>
<td>27.7</td>
</tr>
<tr>
<td><strong>Average closeness among alters</strong></td>
<td></td>
<td></td>
<td>2.4</td>
</tr>
<tr>
<td>Source of relation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relatives</td>
<td>55.0</td>
<td>51.0</td>
<td>54.7</td>
</tr>
<tr>
<td>School/University</td>
<td>4.0</td>
<td>2.0</td>
<td>3.9</td>
</tr>
<tr>
<td>Work</td>
<td>26.3</td>
<td>27.5</td>
<td>26.4</td>
</tr>
<tr>
<td>Neighbours</td>
<td>10.6</td>
<td>11.8</td>
<td>10.7</td>
</tr>
<tr>
<td>Through other friends/relatives</td>
<td>3.3</td>
<td>5.9</td>
<td>3.5</td>
</tr>
<tr>
<td>Other sources</td>
<td>0.7</td>
<td>2.0</td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Number of alters</strong></td>
<td>593</td>
<td>286</td>
<td>879</td>
</tr>
</tbody>
</table>

Source: worker data.

Significant differences exist at 0.05 significance level.
lower than that of Muslims (7.1) though the difference was not statistically significant. Most of the reported relations (around 97 percent) represent strong ties, and the respondent evaluated them as intimate or strong relationships.

Table 7.9 shows a strong evidence for segregation in social networks of Muslim and Coptic workers based on religion. On average, Copts represent only 1.8 percent of Muslims' social network (while their overall proportion in the society was estimated to be around 6 percent). Similarly, only 17.6 percent of alters in the social network of Coptic workers were Muslims.

To measure network density, the workers were asked to evaluate the strength of the relationship between each pair of successive alters with a scale from 1 (representing an intimate relation) to 5 (no relation at all). All household members are assumed to have intimate relationships among themselves. Nearly one third of alters have a weak or no relation at all, the remaining percentage, around 70 percent, have moderate-to-intimate relationship. The average closeness among alters was 2.4, and no significant difference was found by worker's religion.

As Table 7.9 shows, more than half the social relations were with relatives. Workplace proved to be an important context for relationship construction. More than a quarter of alters were known through work. Moreover, the workplace contributed around 58 percent of non-familial relationships. Other sources of social relationships include: school/university (4 percent), neighbourhood (11 percent), through other friend/relative (4 percent), and around one percent through other sources (for example, mosque/church).
7.4.3 Job Search and Job Contacts

Section 3 of the worker questionnaire provides information about respondent's work history. The results about this work history are summarized in the following.

As shown in Table 7.10, informal search for jobs using friends and relatives is very common, and was used to secure about 58 percent of jobs for workers. Around 73 percent of Copts were found to rely on informal search compared with 57 percent of Muslim workers (although the difference was not statistically significant).

Table 7.10 shows strong evidence for segregation in job contacts by religion. Most of Muslims (97 percent) and all Copts have received job information or help from people of the same religion as their own. This result was expected due the high level of segregation in social networks based on religion shown previously in Table 7.9.

The results in Table 7.10 also show that about half the job information comes from relatives of the worker, and two fifths from friends and neighbours (8 percent), in addition to direct contact with the employer (about 5 percent).

Table 7.10 also shows that more than half the job information gained through informal search was received from previous workmates. About 35 percent of jobs were discovered through persons working in the firm where these jobs were; this emphasizes the importance of insider referral for job search and hiring.
Table 7.10: Job search method and characteristics of job contact person by worker’s religion.

<table>
<thead>
<tr>
<th></th>
<th>Muslim Workers</th>
<th>Coptic Workers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Job search method (Q309)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Informal</td>
<td>57.1</td>
<td>72.7</td>
<td>57.9</td>
</tr>
<tr>
<td>Formal/None</td>
<td>42.9</td>
<td>27.3</td>
<td>42.1</td>
</tr>
<tr>
<td><strong>Religion of job contact (Q308)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>97.1*</td>
<td>0.0</td>
<td>91.1</td>
</tr>
<tr>
<td>Copts</td>
<td>2.9</td>
<td>100.0</td>
<td>8.9</td>
</tr>
<tr>
<td><strong>Relationship to job contact (Q307)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative</td>
<td>46.7</td>
<td>66.7</td>
<td>47.7</td>
</tr>
<tr>
<td>Friend</td>
<td>39.0</td>
<td>33.3</td>
<td>38.7</td>
</tr>
<tr>
<td>Neighbour</td>
<td>8.6</td>
<td>0.0</td>
<td>8.1</td>
</tr>
<tr>
<td>Employer</td>
<td>5.7</td>
<td>0.0</td>
<td>5.4</td>
</tr>
<tr>
<td><strong>Ever worked with contact person in the same workplace (Q310)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>54.3</td>
<td>50.0</td>
<td>54.0</td>
</tr>
<tr>
<td>No</td>
<td>45.7</td>
<td>50.0</td>
<td>46.0</td>
</tr>
<tr>
<td><strong>Source of information for contact person (Q309)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Works in same firm</td>
<td>34.6</td>
<td>42.9</td>
<td>35.1</td>
</tr>
<tr>
<td>Employer</td>
<td>16.3</td>
<td>28.6</td>
<td>17.1</td>
</tr>
<tr>
<td>From other friends</td>
<td>48.2</td>
<td>28.6</td>
<td>45.0</td>
</tr>
<tr>
<td>Unknown</td>
<td>1.0</td>
<td>0.0</td>
<td>0.9</td>
</tr>
<tr>
<td>Other</td>
<td>1.9</td>
<td>0.0</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>Number of jobs</strong></td>
<td><strong>136</strong></td>
<td><strong>67</strong></td>
<td><strong>203</strong></td>
</tr>
</tbody>
</table>

*Source: worker data.*

*Significant differences exist at 0.05 significance level.*
7.4.4 Workers' Turnover

As explained earlier, the exit patterns of workers could have a large effect on workplace segregation. Section 3 of the worker questionnaire provides information about start date (Q303) and end date (Q304) of the last three jobs (including the current one) which enables the calculation of the duration in months for these jobs.

Table 7.11 shows that the mean job duration for a worker in the same workplace is high amongst the sampled workers. The mean duration for a Muslim worker is about 10 years, and there is no significant difference in this mean by percentage of Copts in the workplace (firm category). On the other hand, the mean job duration for a Coptic worker is higher (about 11 years) although the difference is not statistically significant.

An important result is that there is a statistically significant difference in the mean job duration for Coptic workers for workplaces with different percentages of Copts. On

<table>
<thead>
<tr>
<th>Table 7.11: Mean job duration for Muslims and Copts by percentage of Copts in the workplace.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean job duration (months)</strong></td>
</tr>
<tr>
<td>Firm category</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Predominately Muslim</td>
</tr>
<tr>
<td>Integrated</td>
</tr>
<tr>
<td>Predominately Coptic</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Number of Jobs</td>
</tr>
</tbody>
</table>

Source: worker data.

*Significant differences exist at 0.05 significance level.
average, Coptic workers tend to stay more than twice as long in workplaces with higher percentages of Copts than in other workplaces (165 versus 80 months respectively).

Moreover, as Figure 7.1 shows, there is a significant difference in the mean job duration between Muslims and Copts in integrated workplaces. Copts tend to leave this kind of integrated workplace much faster than Muslims (about 80 versus 131 months respectively).

This pattern may indicate that Copts' preferences and flow among workplaces may have a greater impact on workplace segregation than those of Muslims. Coptic workers tend to leave integrated workplaces faster and stay in Coptic segregated workplaces for longer. However, there is no significant difference in mean job duration for Muslims in workplaces with varying percentages of Copts.

Figure 7.1: Mean Job Duration for Muslim and Coptic Workers
7.4.5 Change of Workplace Segregation by Religion

Changes in the level of workplace segregation depend on the flow of workers from different religions among workplaces. For example, when a Coptic worker moves from a workplace with a high percentage of Copts to one with a lower percentage this would decrease the overall segregation level and vice-versa. This change is a slow process and may take very long time to happen. This makes it hard to measure since it needs data from distant points in time, which may not be available.

The worker questionnaire contains questions regarding the religious composition of the current and previous workplaces (up to two when available) that the worker had worked in during his work history (Q314 and Q315). Table 7.12 summarizes the change in percentage of Coptic workers between the old and recent workplaces. For example, for Muslim workers who had worked in workplaces with no Copts, in 60 percent of the cases the new workplaces also had no Copts, while around 27 percent moved to integrated workplaces, and the rest moved to workplaces with a high proportion of Copts. In return, around 74 percent of Muslim workers who were working in integrated workplaces moved to segregated ones with no Coptic workers. Similarly, around 89 percent of Muslims who were working in workplaces where Copts are overrepresented had moved to no-Copt workplaces.

Thus the overall pattern of turnover for Muslim workers would increase workplace segregation as the net effect is on the side of moving towards no-Copt workplaces. This pattern can be summarized using the mean difference of the percentages of Coptic workers between old and recent workplaces, which was -3.3 percent for Muslim workers, that is, on average Muslim workers move to workplaces where the proportion of Coptic workers is 3.3 percent less than in their previous work.
### Table 7.12: Change in percentage of Coptic workers in workplaces for Muslim and Coptic workers.

<table>
<thead>
<tr>
<th></th>
<th>Percentage of Copts in the old workplace</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
<td>1-20</td>
<td>&gt;20</td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td><strong>Muslim workers</strong></td>
<td><strong>Percentage of Copts in the new workplace</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>60.0</td>
<td>73.9</td>
<td>88.9</td>
<td>69.4</td>
<td></td>
</tr>
<tr>
<td>1-20</td>
<td>26.7</td>
<td>21.7</td>
<td>11.1</td>
<td>22.6</td>
<td></td>
</tr>
<tr>
<td>&gt;20</td>
<td>13.3</td>
<td>4.3</td>
<td>0.0</td>
<td>8.1</td>
<td></td>
</tr>
<tr>
<td><strong>Mean difference in percentage of Coptic workers</strong></td>
<td>-3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Coptic workers</strong></td>
<td><strong>Percentage of Copts in the new workplace</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None (Predominately Muslim)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>1-20 (Integrated)</td>
<td>-</td>
<td>50.0</td>
<td>33.3</td>
<td>40.0</td>
<td></td>
</tr>
<tr>
<td>&gt;20 (Predominately Coptic)</td>
<td>-</td>
<td>50.0</td>
<td>66.7</td>
<td>60.0</td>
<td></td>
</tr>
<tr>
<td><strong>Mean difference in percentage of Coptic workers</strong></td>
<td>-1.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Number of jobs</strong></td>
<td>28</td>
<td>26</td>
<td>19</td>
<td>73</td>
<td></td>
</tr>
</tbody>
</table>

*Source: worker data.*

On the other hand, the Coptic workers who had been working in highly-Coptic segregated workplaces are more likely to move to similar workplaces (67 percent) than to move to more integrated workplaces (33 percent). And half of Copts working in integrated workplaces moved to highly-Coptic segregated ones.

Although mean difference in percentage of Coptic workers is negative, which indicates that they were moving to more integrated or Muslim-dominated workplaces, it was not statistically different from zero.
7.4.6 Work Preferences and Perception of Discrimination

Workers were asked how important it is to work with employers and other workmates with the same religion as their own, and were asked also about their beliefs that employers, in general, tend to hire people from their religion, and whether there is any kind of discrimination against Copts in Egypt. Table 7.13 summarizes workers’ responses to these questions.

In general, around one quarter of Muslim workers reported that it is important for them to work with Muslim employers. Some of the reasons reported for this preference include (Q402)¹:

- “To get a better treatment, and to avoid problems”
- “To perform religious activities together and to have rest in prayer times”
- “I just feel more comfortable when work with a Muslim employer”
- “Do not like to deal with or to be headed by a Copt”
- “To have the same morals and religious rules”

Similarly, around 8 percent of Muslims preferred to work with other Muslim workmates for one or more of the following reasons (Q404):

- “Feel more comfortable to work with Muslims”
- “To avoid problems and clashes”
- “The relations would be better inside the workplace”
- “Do not like to deal with Copts”

¹ Answers to open questions were translated from Arabic to English. This translation made some different answers in Arabic seem similar when translated into English.
Table 7.13: Workers’ responses to questions about hiring discrimination.

<table>
<thead>
<tr>
<th>Question</th>
<th>Muslim Workers</th>
<th>Coptic Workers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q401: Is it important or not important to work with employers of the same religion as yours?</td>
<td>25.4%</td>
<td>0.0</td>
<td>24.0</td>
</tr>
<tr>
<td>Important</td>
<td>74.6</td>
<td>100.0</td>
<td>76.0</td>
</tr>
<tr>
<td>Not important</td>
<td>9.0</td>
<td>0.0</td>
<td>24.0</td>
</tr>
<tr>
<td>Q403: Is it important or not important to work with workmates of the same religion as yours?</td>
<td>7.9</td>
<td>0.0</td>
<td>7.4</td>
</tr>
<tr>
<td>Important</td>
<td>92.1</td>
<td>100.0</td>
<td>92.6</td>
</tr>
<tr>
<td>Not important</td>
<td>9.0</td>
<td>0.0</td>
<td>24.0</td>
</tr>
<tr>
<td>Q406: Is it good or bad to have workers with different religions in the same workplace?</td>
<td>25.4%</td>
<td>57.1</td>
<td>27.3</td>
</tr>
<tr>
<td>Good</td>
<td>5.3</td>
<td>0.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Bad</td>
<td>69.3</td>
<td>42.9</td>
<td>67.8</td>
</tr>
<tr>
<td>Neutral</td>
<td>10.5</td>
<td>14.3</td>
<td>10.7</td>
</tr>
<tr>
<td>Q408: Do you agree or disagree that Muslims tend to employ each others more than employing Copts?</td>
<td>17.5%</td>
<td>42.9</td>
<td>19.0</td>
</tr>
<tr>
<td>Agree</td>
<td>71.9</td>
<td>42.9</td>
<td>70.2</td>
</tr>
<tr>
<td>Disagree</td>
<td>10.5</td>
<td>14.3</td>
<td>10.7</td>
</tr>
<tr>
<td>Q409: Do you agree or disagree that Copts tend to employ each others more than employing Muslims?</td>
<td>59.6%</td>
<td>42.9</td>
<td>56.7</td>
</tr>
<tr>
<td>Agree</td>
<td>36.0</td>
<td>42.9</td>
<td>36.4</td>
</tr>
<tr>
<td>Disagree</td>
<td>4.4</td>
<td>14.3</td>
<td>5.0</td>
</tr>
<tr>
<td>Neutral</td>
<td>64.2</td>
<td>50.0</td>
<td>82.0</td>
</tr>
<tr>
<td>Q410: Do you agree or disagree that there is discrimination against Copts in Egypt?</td>
<td>3.5%</td>
<td>25.0</td>
<td>4.9</td>
</tr>
<tr>
<td>Agree</td>
<td>64.2</td>
<td>50.0</td>
<td>82.0</td>
</tr>
<tr>
<td>Disagree</td>
<td>12.3</td>
<td>25.0</td>
<td>13.1</td>
</tr>
<tr>
<td>Neutral</td>
<td>80</td>
<td>42</td>
<td>122</td>
</tr>
</tbody>
</table>

Source: worker data.

Significant differences exist at 0.05 significance level.

On the other hand, it was not important for Coptic workers to work with a Coptic employer or other Coptic workmates.
Table 7.13 also shows that about around 57 percent of Coptic workers reported that it is a good thing for workers from different religions to work together within the same workplace compared to 25 percent of Muslim workers, and only 5 percent of Muslim workers think that is bad. The main reasons reported are (Q407):

- "This would spread love and friendship among people"
- "Would decrease sensitivity between Copts and Muslims"
- "Would help exchanging ideas and experiences"
- "Creates good competition"
- "This would bring sense of humour at the workplace"
- "To stop discrimination against Copts and Muslims in work"

Perception of workers of hiring discrimination that employers may practice against Muslim and Coptic workers was assessed by asking workers: "Do you think that Muslims/Copts tend to employ each other than employing Copts/Muslims?" The results in Table 7.13 show that both Copts and Muslims believe that each party practices hiring discrimination against the other. More than two fifths of Coptic workers believe that Muslim employers practice hiring discrimination against Copts. On the other hand about three fifths of Muslim workers believe the opposite, that Coptic employers practice hiring discrimination against Muslim workers.

One of the alarming results was that one quarter of Coptic workers (compared to only 4 percent of Muslim workers) reported they believe that there is discrimination against Copts in Egypt. The main reported manifestations of discrimination were (Q411):

- "Muslims are preferred in some jobs; for example army and police and sensitive positions"
- "Muslims do not treat Copts with the due respect"
- "Difficulties in building and maintenance of churches"
- "Lack of media channels and programs for Copts"
7.4.7 Evidence for Hiring Discrimination

Evidence for hiring discrimination based on religion, practiced by both Muslim and Coptic employers, is presented in Table 7.14. The table shows significant differences in the percentages of Coptic workers in the firm with the employer’s religion, and this indicates a great tendency for the employers to hire workers of the same religion as their own. For example, around 89 percent of Muslim employers run firms with no Coptic workers at all. Similarly, three quarters of the Coptic employers have Copts overrepresented inside their workplaces.

To measure the strength of the relationship between employer’s religion and the percentage of Coptic workers in the firm, the Eta\(^2\) coefficient was calculated to be 0.957 which indicates a high correlation.

Table 7.14: Percent distribution of firms by employer’s religion and percent of Coptic workers in the firm.

<table>
<thead>
<tr>
<th>Percentage of Coptic workers</th>
<th>Muslim Employers</th>
<th>Coptic Employers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>None (Predominately Muslim)</td>
<td>88.6(^1)</td>
<td>0.0</td>
<td>79.5</td>
</tr>
<tr>
<td>1-20 (Integrated)</td>
<td>8.6</td>
<td>25.0</td>
<td>10.3</td>
</tr>
<tr>
<td>&gt;20 (Predominately Coptic)</td>
<td>2.9</td>
<td>75.0</td>
<td>10.3</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Number of firms

<table>
<thead>
<tr>
<th></th>
<th>Number of firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muslim Employers</td>
<td>27</td>
</tr>
<tr>
<td>Coptic Employers</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
</tr>
</tbody>
</table>

Source: worker data.

\(^1\) Significant differences exist at 0.05 significance level.

\(^2\) Eta coefficient = 0.957

\(^2\) Eta coefficient is a nominal by interval measure of association.
7.4.8 Stereotyping

To measure the level of stereotyping that Muslims and Coptic workers might practice towards the others, workers were asked a set of questions (Q405) in the form: Which workers, Coptic or Muslim, do you think work harder, are more honest, more cooperative, etc.

As presented in Table 7.15, more than a quarter of Muslim workers believe that Muslim workers in general are more honest, more cooperative with managers and supervisors, more cooperative with other workmates, and accept lower salaries than Coptic workers. Surprisingly, 18 percent of Muslim workers believe that Copts are more respectful to work rules in contrast to 16 percent who reported that Muslim workers are more respectful. This may be, in part, due to the image the majority may have that minority people have less power to break rules in general, that may also be evident from the relatively high percentage (14 percent) of Muslims who reported that Coptic workers are more cooperative with managers and supervisors.

On the other hand, Coptic workers showed a lesser level of stereotyping against Muslim workers, and they reported that there is no difference between Coptic and Muslim workers for most questions.

Table 7.16 shows the effect of workplace segregation on stereotyping. As shown in the table, there is a general increasing trend in the answer "Copts and Muslims are the same" with the increase of the percentage of Coptic workers in the firm (although there is a significant difference only in the second question, "more honest"). This implies that more contact between Muslim and Coptic workers decreases stereotyping.
Table 7.15: Workers' responses to questions about stereotyping.

<table>
<thead>
<tr>
<th>Q405: Which workers, Coptic or Muslim, do you think are better than the other in each of the following:</th>
<th>Muslim Workers</th>
<th>Coptic Workers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Work harder</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>16</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Copts</td>
<td>5</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>The same</td>
<td>79</td>
<td>90</td>
<td>83</td>
</tr>
<tr>
<td>2- More honest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>26</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>Copts</td>
<td>8</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>The same</td>
<td>66</td>
<td>90</td>
<td>74</td>
</tr>
<tr>
<td>3- More cooperative with managers/supervisors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>24</td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>Copts</td>
<td>14</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>The same</td>
<td>63</td>
<td>93</td>
<td>73</td>
</tr>
<tr>
<td>4- More cooperative with other workmates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>31</td>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td>Copts</td>
<td>8</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>The same</td>
<td>61</td>
<td>85</td>
<td>69</td>
</tr>
<tr>
<td>5- Respect work rules</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>16</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Copts</td>
<td>18</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>The same</td>
<td>66</td>
<td>93</td>
<td>72</td>
</tr>
<tr>
<td>6- Accept lower salary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>26</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>Copts</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>The same</td>
<td>64</td>
<td>90</td>
<td>73</td>
</tr>
<tr>
<td><strong>Number of Workers</strong></td>
<td><strong>80</strong></td>
<td><strong>42</strong></td>
<td><strong>122</strong></td>
</tr>
</tbody>
</table>

Source: worker data.

Significant differences exist at 0.05 significance level.
Table 7.16: Workers’ responses to some questions about stereotyping by percentage of Coptic workers.

<table>
<thead>
<tr>
<th>Percentage of Coptic Workers</th>
<th>None</th>
<th>1-20</th>
<th>&gt;20</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q405: Which workers, Coptic or Muslim, do you think are better than the other in each of the following:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1- Work harder</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>15.4</td>
<td>10.5</td>
<td>6.8</td>
<td>10.7</td>
</tr>
<tr>
<td>Copts</td>
<td>2.6</td>
<td>16.5</td>
<td>2.3</td>
<td>6.6</td>
</tr>
<tr>
<td>The same</td>
<td>82.1</td>
<td>73.7</td>
<td>80.9</td>
<td>82.6</td>
</tr>
<tr>
<td>2- More honest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>25.6</td>
<td>18.4</td>
<td>9.1</td>
<td>17.4</td>
</tr>
<tr>
<td>Copts</td>
<td>7.7</td>
<td>16.8</td>
<td>2.3</td>
<td>8.3</td>
</tr>
<tr>
<td>The same</td>
<td>66.7</td>
<td>65.8</td>
<td>88.6</td>
<td>74.4</td>
</tr>
<tr>
<td>3- More cooperative with managers/supervisors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>25.6</td>
<td>15.8</td>
<td>9.1</td>
<td>16.5</td>
</tr>
<tr>
<td>Copts</td>
<td>7.7</td>
<td>13.2</td>
<td>11.4</td>
<td>10.7</td>
</tr>
<tr>
<td>The same</td>
<td>66.7</td>
<td>71.1</td>
<td>79.5</td>
<td>72.7</td>
</tr>
<tr>
<td>4- More cooperative with other workmates</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>30.8</td>
<td>26.9</td>
<td>9.1</td>
<td>22.3</td>
</tr>
<tr>
<td>Copts</td>
<td>0.0</td>
<td>10.5</td>
<td>13.6</td>
<td>8.3</td>
</tr>
<tr>
<td>The same</td>
<td>69.2</td>
<td>60.5</td>
<td>77.3</td>
<td>69.4</td>
</tr>
<tr>
<td>5- Respect work rules</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>12.8</td>
<td>15.8</td>
<td>4.5</td>
<td>10.7</td>
</tr>
<tr>
<td>Copts</td>
<td>15.4</td>
<td>15.8</td>
<td>20.5</td>
<td>17.4</td>
</tr>
<tr>
<td>The same</td>
<td>71.8</td>
<td>68.4</td>
<td>75.0</td>
<td>71.9</td>
</tr>
<tr>
<td>6- Accept lower salary</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>25.6</td>
<td>18.4</td>
<td>9.1</td>
<td>17.4</td>
</tr>
<tr>
<td>Copts</td>
<td>5.1</td>
<td>10.5</td>
<td>13.6</td>
<td>9.9</td>
</tr>
<tr>
<td>The same</td>
<td>69.2</td>
<td>71.1</td>
<td>77.3</td>
<td>72.7</td>
</tr>
<tr>
<td>Number of workers</td>
<td>39</td>
<td>38</td>
<td>45</td>
<td>122</td>
</tr>
</tbody>
</table>

Source: worker data.

*Significant differences exist at 0.05 significance level.*
### 7.5 Chapter Conclusion

This chapter presented the results of the interviews with workers and employers. The main findings include:

- Both workers and employers rely on friends and relatives for job search and hiring; 58 percent of jobs were secured using this informal methods.
- Job contacts are segregated based on religion, Copts and Muslims are more likely to pass job information to others of the same religion.
- A high correlation was found between employers' religion and the proportion of Copts in the workplace indicating hiring discrimination.
- There is a high level of perception of discrimination: half of workers, Muslims and Copts, believe that employers tend to hire workers of the same religion as their own.
- There is a high level of social segregation. Social networks for both Muslims and Copts tend be religiously homophilous; however, they have similar structures and sizes.
- Exit patterns play an important role in workplace segregation. For example, on average, Coptic workers tend to stay more than twice as long in workplaces with a high percentage of Copts than in other workplaces.

The results of the statistical analysis give a snapshot to the current levels of segregation and homophily and the correlation between some variables of interest. However, this analysis does not explain how these levels were obtained, that is, how social and workplace segregation co-emerge and develop over time. Other analytical tools are needed to address this question of emergence. In the next chapter a simulation model is suggested to help in this regard.
8 AGENT-BASED MODEL FOR SOCIAL AND WORKPLACE SEGREGATION

8.1 Aims of This Chapter

The intent of this chapter is to present a simulation model for the relationship between workplace segregation (based on race, ethnicity and/or religion) and the segregation of the social networks of individuals. The model creates an artificial society where agents (people) use their social networks to search for jobs. As simulation time passes, agents change their social networks by creating new social links (ties) with other agents while some other links dissolve. Also, the composition of workplaces may change through the processes of workers' firing and hiring.

The model describes this process of continuous change in the composition of workplaces and social networks of agents, and how this change affects levels of workplace segregation, segregation of the social networks of agents and the unemployment levels of minority and majority groups. The simulated behaviour of agents (in creating and dissolving social links) and firms (in firing and hiring workers) and the model's parameters will be set in the light of the results of statistical analysis of the empirical data presented earlier in Chapter 7.

After this introduction, a general framework for the relationship between social segregation and workplace segregation is presented in Section 8.2, then, a detailed description of the proposed agent-based simulation model is presented in Section
8.3 Finally in Section 8.4, some basic experiments with the model are presented to test its validity.

8.2 General Framework for the Relationship between Social and Workplace Segregation

The proposed framework describes the dynamic relationships between social segregation, workplace segregation, mean homophily level, and referral hiring (as summarized in Figure 8.1).

Social segregation may directly affect workplace segregation (each arrow in Figure 8.1 indicates a causal relationship between the variables at its two ends). When firms tend to hire new workers through referrals, especially referrals from other existing workers (insider referrals), and when social networks of people (which represent the pool of candidate workers) tend to be segregated and homophilous, this would promote workplaces segregation. On the other hand when workplaces become more segregated this would reduce the chance of intergroup contact, that is, the chance for

![Figure 8.1: A framework to study social and workplace segregation](image-url)
people from different social groups to meet and create social relations at work, and this would increase social segregation.

An individual's homophily level works is a bias towards creating social ties with similar others (McPherson et al. 2001). So, high levels of homophily lead to the creation of homophilous social networks, which in turn increase social segregation. On the other hand, when social networks of people become less segregated, this means that people have a higher chance to have contacts with others of different social groups, and this would hinder their homophilous attitudes and vice-versa.

The relationship between homophily levels and workplace segregation can be described as follows. High levels of homophily among individuals may affect workplace segregation through its effects on the exit patterns of workers. As presented in the previous chapter (and shown in Table 7.11) and supported by other empirical studies (for example, S0rensen 2004), workers with high levels of homophily tend to stay longer in segregated workplaces where their groups are over-represented than other workplaces. Also, high homophily levels among employers would promote hiring discrimination (employers' preferences to hire workers of the same social group as their own (Becker 1971)), and this would increase workplace segregation. In return, workplace segregation may affect homophily levels of individuals. Segregated workplaces reduce the chance for inter-group contact to happen, which promotes homophilous attitudes and vice versa.

8.3 Model Description

In the following, an agent-based simulation model for social and workplace segregation (based on the general framework presented in the previous section) is presented. Firstly, the model's specifications are introduced in the following subsection.
8.3.1 Agents

The model creates an artificial society of \( N \) equally-qualified agents (persons). Each agent can belong to one of two social groups: \( A \) or \( B \) (these groups can be Copts and Muslims, Blacks and Whites, or simply Red and Green). Assume that \( A \) is a minority group, and its proportion in the society is \( P \) (where \( 0<P<0.5 \)). Thus, there are \( PN \) agents belong to the minority group, and \( (1-P)N \) agents are majority-group members.

8.3.2 Social Networks

As discussed in earlier Section 6.6.2, a social network (ego-centric social network) is operationally defined as a "...set of people who are most likely to be sources of a variety of rewarding interactions, such as discussing a personal problem, borrowing money, or social recreation" (McCallister & Fischer 1983:78), that is what is called "core network". Creation and dissolving of what are called "social links" will depend on this definition. For example, this definition imposes restrictions on the size of the social network (as explained below). Social links need some time to develop (and dissolve).

8.3.2.1 Network Size

Each agent has a social network (an ego-centric social network), and the maximum possible size of this network (maximum number of alters at one time) is \( S_i \), \( i=1, 2,..., N \). Network size can be differ among individuals and is assumed to have a normal distribution with mean and variance to be estimated from empirical data (some simplified examples that will follow assume a constant value for network size). Since people need to invest some resources (especially time) in maintaining their social relationships, they can not keep relationships (especially the 'core relationships' as explained earlier) with an unlimited number of people. Thus, the assumption that each agent has a maximum limit to its social network's size seems plausible.
8.3.2.2 Homophily Levels

Agents create social links with each other based on their homophily levels, $h_i$. An agent's homophily level expresses its tendency (or bias) to create social links with other agents of the same colour (group) as its own. For example, a Red agent would create a social link to another Red agent with the following probability:\(^1\)

$$\text{Prob (Red to Red)} = \begin{cases} p + h(1-p) & \text{if } p > 0 \\ 0 & \text{Otherwise} \end{cases} \quad (8-1)$$

and it creates a link to a Green agent with the complement probability.

In the previous equation, (small) $p$ refers to the proportion of Red agents available within the context of link creation. For example, when a Red agent joins a workplace, and it is about to create a social link to one of the existing co-workers, $p$ would refer to the proportion of other Red workers (who are not already linked with the agent) in that workplace.

Based on the equation (8-1), with $h=0$, all links are created at random, and all agents will have the same probability $p$ to create links with Red agents and probability $1-p$ to create links with Green agents. On the other hand, with the maximum homophily, $h=1$, a Red (Green) agent would create links to other Red (Green) agents (if such agents are available) with probability one, otherwise with Green (Red) agents.

\(^1\) All formulas applied to Red agents can be applied to Green agents by replacing $p$ with $(1-p)$. For example, \text{Prob (Green to Green)} = \begin{cases} (1-p) + hp & \text{if } p < 1 \\ 0 & \text{otherwise} \end{cases}
It should be stressed here that a Red (Green) agent with a homophily of 1 can still create social links with other Green (Red) agents if it faces a situation where there are no other Red (Green) agents. In other words, an agent acts according to the following sequence when creating a social link. Firstly, it decides (with some probability) whether or not to create a link. Secondly, it decides (with another probability) with whom it would like to create this link. Defining homophily in this way, as biasness towards similar people, differentiates it from xenophobia which indicates hatred and hostility towards dissimilar people.

**Updating Agents’ Homophily Levels**

Agents are initialized with a zero homophily level, $H$. However, an agent's homophily level changes over time, and it is assumed to depend – in addition to its current level - on five factors: (1) composition of its social network, (2) average homophily level of alters in its social network, (3) composition of its workplace, (4) average homophily level of its workmates, and (5) overall average homophily of all agents in society. Thus, for a Red agent, its homophily level at time $t+1$, $h_{t+1}$, can be written as a weighted average of its homophily level $h_t$ and the effects of these five factors:

$$h_{t+1} = h_t + a_1(p_a - P)(1-P) + a_2(\text{mean homophily of alters}) + a_3(p_w - P)(1-P) + a_4$$

$$\text{(mean homophily of workmates)} + a_5(\text{overall mean homophily of all agents})] / (1 + a_1 + a_2 + a_3 + a_4 + a_5)$$

where $h_t$ is agent’s homophily level at time $t$, $p_a$ is the proportion of alters of Red colour in agent’s social network, $p_w$ proportion of workmates of Red colour, and $a_1$, $a_2$, $a_3$, $a_4$ and $a_5$ are constants.

**8.3.2.3 Directed versus Undirected Links**

In forming their social networks agents create directed (asymmetric), rather than undirected (symmetric), social links with each other. There are two reasons behind
this assumption. The first reason is the potential asymmetry in the evaluation of social links, and the asymmetry in job knowledge and access. Asymmetry in the evaluation of social links implies that two persons \(X\) and \(Y\) may evaluate the importance or the strength of their relationship differently. \(X\) may consider \(Y\) as one of his/her best friends (or one of his core network) while \(Y\) may think that this relationship to \(X\) is not intimate at all. On the other hand, asymmetry in job knowledge and access implies that job information and/or referral may flow from person \(X\) to person \(Y\) but not in the opposite direction. For example, "... a bank president probably can recommend a bank teller for a position but a bank teller probably cannot recommend a bank president." (Tassier & Menczer 2005:10).

The second reason for choosing directed links is a pragmatic one. When building models involving social networks, it is generally easier and more flexible to deal with directed links more than undirected ones. For instance, it is not always possible (or at least, not easy) to create an artificial society with agents that have a specific distribution of number of undirected links, while it is always possible to create that distribution of directed links. For example, it is not possible to create a network of five agents (nodes) each having three undirected links.

### 8.3.2.4 Origins of Social Relations

Fischer (1982) stated that "most adults encounter people through their families, at work, in the neighbourhood, in organizations, or through introduction by friends or relatives;...; only rarely do chance meetings, in a bar, at an auction, or such become anything other than brief encounters." (Fischer 1982:4). In line with Fischer, agents are assumed to create their social links through three sources: workplaces, other friends/relatives (other links) and/or random acquaintances.

At each time step of a simulation run, each working agent has a probability \(L_w\) to create a social link to one of the existing co-workers. If a working agent decides to
create a link through its workplace it would select (based on its homophily level) one of the existing co-workers to create this link to. Also, at each time step, each agent has a probability $L_N$ to create a new link with another agent through its existing social network (in other words, with another agent who is already linked with one of agent’s social network). Finally, at each time step, each agent has a probability $L_R$ to create a new link with another random agent.

The values for the probabilities $L_W$, $L_N$ and $L_R$ were inspired by the results of the empirical study. These results show that about 30 percent of social links originated within workplaces, more than 65 percent come from/through relatives, other friends and neighbours, and the remaining proportion of links is created through random encounters. Similar results were also found in other empirical literature (for example Grossetti 2005). So, the numerical values for $L_W$, $L_N$ and $L_R$ were chosen to get similar distribution of social links according to their origin at the end of simulation (although social networks are initialized as random networks).

Finally, any extra links exceeding an agent’s maximum network size are deleted randomly. Although the reduction of the number of links to a “maximum limit” seems artificial, it is a useful simplification. People normally do not entirely drop their relationships; rather, they change their evaluation to their social relationships. Using our definition of the core social network, any social links with low evaluation will be considered deleted as they will fall outside the definition’s boundaries. Other alternatives to deleting social links randomly include deleting them with some probability (for example, probability proportional to the current number of links or link age). Since it is not believed that these complications will greatly affect the results, the simplified assumption of random deletion will be applied.
8.3.3 Workplaces and Jobs

The artificial labour market includes a number of firms, $F$, each of which has a number of jobs ($\Theta$) which remains constant throughout a single simulation run. It is assumed that all the jobs are identical, and need the same level of skills and qualifications (so, any agent can do any job with the same efficiency). Each firm has a "colour" which indicates the group identity of its owner/manager (employer). Suppose that proportion of Red firms is $P$. Hiring discrimination for a firm $f$ at any time step, $D_f = (\text{hiring-discrimination-constant}) \times (\text{mean homophily level of workers})$, where \text{hiring-discrimination-constant} is a constant that indicates to what extent the homophily attitudes of employers are translated to hiring discrimination. For example, when there are some anti-discrimination laws for hiring workers, this constant should take a low value.

Each firm, $f$, has a total of $t_f$ agents (workers) consisting of $r_f$ Red agents and $g_f$ Green agents, such that $t_f = r_f + g_f$. Let $p_f = r_f / t_f$ be the proportion of the minority (Red) group inside this firm. Let $U$, $U_m$, and $U_g$ denote the overall unemployment, minority unemployment and majority unemployment levels respectively. Finally, let $T = \sum_f t_f$ denote total number of currently working agents.

8.3.3.1 Hiring Process

At each time step, each firm will hire a number of workers to fill its vacant jobs. Firms can hire new workers (agents) either through formal channels or through referrals from current workers. Let $R$ denote the prevalence of referral hiring in the artificial labour market. When hiring a new worker, a firm uses referrals from current workers with probability $R$, and uses formal methods of hiring (for example advertising vacancies) with probability $1-R$. 

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If a firm decided to hire a worker through formal methods it would simply pick one of the unemployed workers at random. In case of hiring through referrals from current workers, firms may practice hiring discrimination against the candidate workers. Let $G$ represent the group of candidate workers, i.e., unemployed workers who have social links with at least one of the current workers in the firm (if no such workers exist, firms hire through formal channels). For example, a Red firm would hire a Red agent through referral with the probability:

$$\begin{align*}
\text{Prob (Red firm to hire Red worker through referral)} &= \begin{cases} 
  p + D_f (1 - p) & \text{if } p > 0 \\
  0 & \text{Otherwise}
\end{cases} 
\end{align*}$$

and it hires a Green agent with the complement probability, where $p$ refers to the proportion of Red agents in the group $G$.

### 8.3.3.2 Firing Process

The results of the empirical study, presented earlier in Chapter 7, show that workers tend to stay longer in workplaces where they are overrepresented than in other workplaces. Based on these empirical results, it is assumed that at each time step of the simulation run, each working agent will be fired from (or will exit) its workplace with some probability. This probability should depend on the agent's homophily level, $h$, and how far the proportion of its group inside the workplace, $p$, is from the overall group proportion in the society, $P$. The probability of a Red agent to be fired from (or to exit) its workplace at any time step is given by:

$$E_R = \beta (1 + h (P - p))$$ (8-4)
where $\beta$ is a constant regulating the speed of workers' turnover in the simulated labour market\(^2\).

Based on equation (8-4), for an agent with zero-homophily, its probability to be fired would be constant and equals $\beta$ regardless of the proportion, $p$, of its group in the workplace (which is intuitive). On the other hand, an agent with a non-zero homophily, $h$, would have an increasing probability to be fired as its group's proportion $p$ decreases, and vice versa.

Introducing homophily level as a decisive factor (in addition to the group proportion $p$) in determining exit levels of workers seems plausible. There should be no reason for some worker to have an increasing probability (with decreasing level of $p$) to leave its job when he/she is absolutely egalitarian. On the other hand, if a worker has a high level of homophily it would plausible to assume that he/she will be happier when working in a workplace with more similar co-workers.

### 8.3.4 Statistics and Indices

In the current model, the main objective is measuring the level of segregation of the global social network and the level of workplace segregation, in addition to unemployment rates for minority and majority groups. The segregation index (presented in detail in Chapter 4), $S$, developed by Freeman (1978) will be used to measure the level of segregation in the global social network of agents. $S$ measures the deviation of the distribution of links between two agents from different groups from the distribution expected when links are created at random (Freeman 1978:416).

\(^2\) Analogously, for a Green agent its probability to be fired is $E_G = \beta \left(1 + h (p - P)\right)$.
Two indices (presented earlier in Chapter 2) will be used to measure workplace segregation: the Gini index, $G$, and the modified Gini index $\hat{G}$. The Gini index, $G$ was developed by Jahn, Schmid, and Schrag (1947), and it measures the deviation of the distribution of agents of different colours in firms from the case of evenness (all firms have the same proportion of Red agents equal to their overall proportion $P$). On the other hand, the modified Gini index, $\hat{G}$, measures the deviation of the segregation curve from the curve of randomness (which represent the case in which workers are randomly allocated to firms). Thus, $G$ is more appropriate when the main concern is the actual level of segregation among firms (even if this segregation is due to just chance or random effects), whereas $\hat{G}$ is used to measure the systematic or net segregation, that is, the segregation level due to the behaviour of agents and firms not due to random effects.

8.3.5 Model Dynamics

Figure 8.2 shows the logic of the dynamics of the simulation model (see Appendix C for a complete list of the model implemented in NetLogo 4.0.3). The simulation starts by creating an artificial society of a number of agents from two different groups and a random social network for each agent. A number of firms $F$ are created, each with a specified number of jobs $e_i$, and then agents are assigned to these firms randomly. The final step of the initialization process is to calculate and plot statistics for the initial stage, which include indices of segregation for workplaces and social networks and levels of unemployment for minority and majority groups. Then at each time step:

1. Each agent will be fired with the proper probability (as described earlier)

2. Each firm will hire a number of agents, either randomly (through formal channels) or through referrals from current workers, depending on the probability $R$. 

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3. Agents update their homophily levels based on formula (8-2)

4. Agents update their social networks. Each agent creates a link through the workplace (if the agent is currently employed), through other links and/or randomly with the proper probabilities \( L_W, L_N \) or \( L_R \) respectively.

5. Statistics are calculated and plotted.

---

Create an artificial society of \( N \) agents
Assign agents to groups A and B
Create a random social network (a number of links) for each agent
Create a labour market of \( F \) firms each with \( \theta_f \) jobs
Assign agents to firms randomly
Measure and plot statistics

For each time step
   For each agent
      Fire the agent with the proper probabilities \( E_R \) and \( E_A \)
   End for
   For each firm
      Hire workers to fill the vacant jobs through formal channels or referrals
      If firm fails to hire through referral it would use formal methods of hiring
   End for
   For each agent
      Update homophily level
      Create a new link with probability \( L_N \) through existing links
      Create a new link with probability \( L_R \) to a random agent
      If agent is working
         Create a new link with probability \( L_W \) to one of other co-workers
      End if
   End for
   Measure and plot statistics
End for

Figure 8.2: Paused code of the Dynamics of the Simulation Model
8.4 Simulation Results

In the following, the results of the simulation model for workplace segregation, social segregation and unemployment levels of minority and majority groups are summarized. The results are based on the parameter values shown in Table 8.1.

Table 8.1: Parameters values and description for the basic experiments.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sim-run</td>
<td>Number of simulation runs</td>
<td>30</td>
</tr>
<tr>
<td>Sim-time</td>
<td>Number of time steps for each simulation run</td>
<td>500</td>
</tr>
<tr>
<td>$\alpha_1, \alpha_2, \alpha_3, \alpha_4$ and $\alpha_5$</td>
<td>Constants regulating the change in homophily levels.</td>
<td>0.4</td>
</tr>
<tr>
<td>$B$</td>
<td>A constant regulating the probability of an agent to be fired.</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Agents</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$N$</td>
<td>Total number of agents</td>
<td>1000</td>
</tr>
<tr>
<td>$P$</td>
<td>Proportion of the minority (Red) group</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>Social Networks</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$S_i$</td>
<td>Size of social networks of agents</td>
<td>10</td>
</tr>
<tr>
<td>$L_w$</td>
<td>Probability of creating a new link with other co-workers</td>
<td>0.3</td>
</tr>
<tr>
<td>$L_N$</td>
<td>Probability of creating a new link through current links</td>
<td>0.5</td>
</tr>
<tr>
<td>$L_R$</td>
<td>Probability of creating a new link randomly</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>Workplaces</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hiring-discrimination-constant</td>
<td>Constant regulating the effect of hiring discrimination</td>
<td>1.0</td>
</tr>
<tr>
<td>$F$</td>
<td>Number of firms</td>
<td>40</td>
</tr>
<tr>
<td>$\theta$</td>
<td>Number of jobs in each firm</td>
<td>20</td>
</tr>
</tbody>
</table>

8.4.1 Referral Hiring, Workplace Segregation and Social Segregation

The results summarized in Figure 8.3 show the co-emergence of workplace segregation and social segregation with different levels of referral hiring. Both workplace segregation and social segregation increase with increasing level of
referral hiring. An interesting result is that significant levels of workplace segregation and social segregation may evolve even when hiring of workers occurs mainly through formal channels and the society is initially integrated. The random allocation of workers to firms may introduce some level of workplace segregation which triggers an increasing (but still low) level of homophily and social segregation which, in turn, promotes workplace segregation (through the exit patterns of workers), and so on.

![Figure 8.3: Emergence of workplace segregation and social segregation for different levels of referral hiring.](image)

**8.4.2 Homophily Levels**

The results of the simulation show that even when the model starts with a zero-level of homophily, agents of majority groups, generally, end with higher homophily levels than those of minority groups (as shown in Figure 8.4). The main reason is minority people have a higher chance to have outgroup links (through social networks or workplaces) than majority group members.
8.4.3 Employment Inequality

An interesting result of the simulation model is that increasing levels of referral hiring would be beneficial for minority groups when the population is highly segregated and harmful otherwise. Figure 8.5 shows that minority unemployment generally decreases with increasing level of referral hiring until it reaches its minimum level (with $R=0.8$ in our experiment), then increases after that. When referral hiring is low (hence, lower levels of workplace and social segregation), all unemployed agents will have the same chance to join any workplace with vacant jobs, and will have the same probability to exit their workplaces, hence all social groups will have similar unemployment levels (around 20 percent in our experiment). This is clearly illustrated in Figure 8.6 with the case of $R=0$. But with higher levels of referral hiring (the cases $R=0.8$ and $R=1$), minority unemployment tends to be higher than majority unemployment at the early stage of simulation run, which is characterized by (still) lower levels of workplace and social segregation. However, as time passes and segregation increases, referral hiring benefits the minority’s employment. For
Figure 8.5: Unemployment levels of minority group for different levels of referral hiring, $R$.

Example, when $R=0.8$, minority unemployment attains a stationary level of 0.16. When the level of referral hiring is close to one, a complete segregation of workplaces (and social networks) is reached and the firms are distributed proportionally between minority and majority groups, hence all groups will have the same unemployment level (0.2).

Figure 8.6: Unemployment levels of minority group across time for different levels of referral hiring, $R$. 

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This result regarding the relationship between referral hiring and minority employment is consistent with the result of Tassier and Menczer’s model (2005) where they showed that:

"More random social networks [majority groups] yield higher employment rates than less random social networks [minority groups] if the population is integrated [in early stage of our simulation] or information flows about job vacancies are random [low level of referral hiring]. However if the population is highly segregated and information flows about job vacancies are non-random [with high level of referral hiring in later stages of simulation run] then less random social networks have higher employment rates than more random social networks. This second finding holds because non-random social networks allow a group to better contain job information inside the group when a population is segregated." (Tassier & Menczer 2005:1).

8.5 Chapter Conclusion

In this chapter a general framework is introduced which describes the dynamic relationships between social segregation, workplace segregation, homophily levels, and referral hiring. An agent-based simulation model was developed and the results of the model support the proposed framework. The results of the simulation model indicated that the labour market may experience significant levels of workplace segregation and social segregation even when hiring of workers occurs mainly through formal channels. The results also show that majority groups tend to be more homophilous than minority groups, and referral hiring may be beneficial for minority groups especially when the population is highly segregated.
9 MODEL VERIFICATION AND VALIDATION

9.1 Aims of This Chapter

In this chapter, verification and validation are discussed for the model developed earlier in the previous chapter. In Section 9.2, definitions of model validation and verification are presented, then the methodology adopted for validation and verification of the proposed model is presented in Section 9.3. The conceptual model validation which validates the most important assumptions of the model is discussed in Section 9.4, and the computerized model verification is discussed in Section 9.5. Finally, the operational validation of the model is tested in Section 9.6 through comparison of the simulated results against empirical data from the Egyptian labour market and social networks.

9.2 Definitions

Many definitions of model validation exist in the literature (for example Balci 1994, Schlesinger 1979, and US Department of Defense 2003). Most of these definitions agree on the main aspects of the validation process. According to US Department of Defense, validation is:

"the [process] of determining the degree to which a model is an [accurate representation] of the real-world from the perspective of the [intended uses] of the model" (US Department of Defense 2003:13).

Similarly, Schlesinger defined validation as:
"a substantiation that a computerised model within its domain of applicability possesses a [satisfactory range of accuracy] consistent with the [intended application] of the model" (Schlesinger 1979:103).

Based on these definitions, the main aspects of model validation (described with bold words and phrases in the previous definitions) can be summarized as:

- **Validation is a process.** There can be no one test with which the model validity can be judged. There are many tests and techniques to validate simulation models (Balci 1994) from which the researcher has to select the appropriate ones (based on model's objectives and/or available data). Generally, as a model passes various tests, confidence in the model is enhanced.

- **No model can be absolutely valid.** Since the model created is an approximation of the actual system, some errors are unavoidable. So, rejecting a model because it fails to reproduce an exact replica of the real system is not acceptable (Martis 2006).

- **A model should be valid for the purpose for which it is constructed,** and it should be judged for its usefulness rather than its absolute validity. For example, many of simulation models in social sciences are built to explain the dynamics or the emergence of some social phenomenon rather than to predict it (a simple example is Schelling's model of segregation (1971) presented in Section 5.10). These models should be judged for their usefulness in explanation rather than their power of prediction or replication of existing social systems.
9.3 Methodology for Validation

The methodology adopted here for validating the simulation model is based on the simplified version of the modelling process illustrated in Figure 9.1 (adapted from Sargent 2005). One starts by identifying the problem entity of a research. The 'problem entity' is the target (Gilbert & Troitzsch 2005) system to be modelled (Sargent 2005). For example, the dynamics and emergence of social and workplace segregation would be considered the problem entity of this thesis.

The conceptual model is "the mathematical/logical/verbal representation (mimic) of the problem entity developed for a particular study" (Sargent 2005:132). A conceptual model is developed through an analysis and modelling phase, and it is (or should be)
based on some existing theories and assumptions around the problem entity. Conceptual model validation is defined as:

"[the process of] determining that the theories and assumptions underlying the conceptual model are correct and that the model representation of the problem entity is "reasonable" for the intended purpose of the model." (Sargent 2005:132)

In most social simulation models, the assumptions and theories used to build the conceptual models determine the micro behaviour of agents. A simple example is Schelling's model of segregation (1971) which assumes that an agent would move to a new neighbourhood if it is not happy with the proportion of neighbours of different colours. For a model to be valid, it should show similarity to the target system in both the micro-level behaviour of agents and the macro level behaviour of the system output. Gilbert (2002) stresses the importance of this two-level validation of models:

"One has to validate a model at both the individual level and at the macro level before one can suggest that the simulation is a good representation of the social processes it is aiming to model." (Gilbert 2002:9)

For the current thesis, the conceptual model is illustrated by Figure 9.2. The most important assumption (among others discussed in following sections) behind the relationships in this conceptual model is that: inter-ethnic group contact among people would increase their tolerance (reduce homophily), and make them more receptive to other people of different ethnic, racial, and/or religious background (Amir 1969).

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1 This figure is a copy from Figure 8.1, and was copied here for the convenience of the reader.
Using referral hiring, increases social segregation and workplace segregation homophily levels.

Figure 9.2: A framework to study social and workplace segregation

Once a conceptual model is obtained, one can turn to its translation into a computerized model through a computer programming and implementation phase (Gilbert & Troitzsch 2005). So, the computerized model, in Figure 9.1, "is the conceptual model implemented on a computer" (Sargent 2005:132). The complete computer code of the computerized simulation model for social and workplace segregation is presented in Appendix C.

One has to make sure that this process of translating a conceptual model into a computerized model is accurate through computerized model verification (or simply "verification"). Verification can be defined as:

"the process of determining that a model implementation and its associated data accurately represent the developer's conceptual description and specifications" (US Department of Defense 2003:13)

As Balci (1994) explains, "model validation deals with building the right model ... [while] model verification deals with building the model right" (Balci 1994:121-123).
The computerized model is used to generate simulated data. These simulated data can then be compared, through the operational validation process, with (real) collected data to check whether the model generates outcomes similar to those produced by the actual processes operating in the social world (Gilbert & Troitzsch 2005). Operational validation can be defined as:

"determining that the model's output behaviour has sufficient accuracy for the model's intended purpose over the domain of the model's intended applicability" (Sargent 2005:132).

Finally, the data used to develop the model (during analysis and conceptual model developing), estimate model's parameters, and test the model (during the operational validation) should be valid in the first place (Gilbert & Troitzsch 2005). Data validity is defined as:

"ensuring that the data necessary for model building, model evaluation and testing, and conducting the model experiments to solve the problem are adequate and correct" (Sargent 2005:132).

As Figure 9.1 illustrates, after the model has been conceptually validated, verified and operationally validated, it can be used for theory development about the problem entity. Inferences about the problem entity are obtained by conducting computer experiments on the computerized model in the experimentation phase (Sargent 2005).

In the remaining sections of this chapter, conceptual model validation, computerized model verification, operational validation, and data validation are presented and discussed for the proposed simulation model of the current thesis.
9.4 Conceptual Model Validation

As discussed earlier in this chapter, during conceptual model validation one needs to ensure that all theories and assumptions underlying the conceptual model are correct and that the model under investigation represents the problem entity in a reasonable way (Sargent 2005). To validate the proposed conceptual model of social and workplace segregation, presented in Figure 9.2, the following underlying assumptions and relationships among the model's components need to be tested:

1. The Contact Hypothesis
2. The mutual relationship between social segregation and homophily levels
3. The mutual relationship between workplace segregation and homophily levels
4. The mutual relationship between social and workplace segregation

These four assumptions have been validated empirically (against available empirical data and other empirical studies), and theoretically (against other existing theories).

9.4.1 The Contact Hypothesis

The central premise of many of the relationships in the conceptual model (Figure 9.2) is that more intergroup contact between different social (ethnic, racial and/or religious) groups would reduce prejudice and hostility and promote tolerance, which is classically known as the Contact Hypothesis (Allport 1954).

The Contact Hypothesis has been discussed in detail in Chapter 2, and it has been shown that significant attitude changes due to intergroup contact have been reported in many earlier empirical studies across different contexts (Ellison & Powers 1994, Emerson et al. 2002, Robinson 1980, Sigelman & Welch 1993, Williams 1964,
It has been shown also that four key conditions should be satisfied before the desired effects of contact could be expected (Allport 1954):

1. Contact should occur between equal-status groups
2. Contact should be acquaintance potential (frequent, direct, intimate, etc.)
3. Contacting groups should pursue common objectives
4. There should be social and institutional support for the contact

According to the proposed conceptual model, contact among people (agents) takes place mainly through workplaces (with other workmates) and social networks (with friends). With a huge literature confirming the impact of social networks on attitude and behaviour change (for example, Duncan et al. 1968, Latané 1981, 1996), it seems reasonable to assume that having social ties with outgroup members would decrease prejudice and homophily.

The proposed virtual workplace satisfies, to a reasonable extent, Allport's conditions. The contact occurs among equal-status co-workers. Contact among people at the same workplace usually occurs frequently (every day), for long periods, mostly face-to-face. The success of the enterprise is beneficial to all workers, regardless of group identity, and this represents a common objective. Finally, in most cases, authority in workplace (for example, the employer) would support established norms of acceptance and cooperation for the benefit of the enterprise (Pettigrew 1998).

The empirical data gathered by the researcher is consistent with previous theoretical and empirical research on the effect of contact, especially within workplaces, on reducing prejudice and homophily. Table 9.1 shows that a significant (although not strong, since Cramer's V is around 0.3) relationship exists between percentage of alters' of the same religion and the percentage of Coptic workers in firms for Muslim and Coptic workers. For Muslim workers, percentage of Coptic alters (friends) in their
social networks significantly increases as the percentage of Coptic workers in their workplace increases (from only 1.6 percent for firms with no Copts to 21.9 percent in firms with 20 percent or more Coptic workers). A similar relationship exists for Coptic workers where the percentage of Muslim alters in their social networks doubles from 29.7 percent in firms with 20 percent or more Copts to 63.8 percent with firms with 1-20 percent Copts. This implies that increasing the contact between Muslims and Copts within workplaces would increase the chance for intergroup social ties to develop and hence lower levels of homophily would prevail.

Once the Contact Hypothesis is granted to be a reasonable assumption in our conceptual model, it could be used to explain the most of the remaining proposed relationships in the model, as follows.
Table 9.1: Percent distribution of alters' religious identity by percentage of Coptic workers in firms for Muslim and Coptic workers.

<table>
<thead>
<tr>
<th>Percentage of Coptic Workers in the Firm</th>
<th>None</th>
<th>1-20</th>
<th>More than 20%</th>
<th>N of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Muslim Workers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Alters' Religious Identity</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>98.4</td>
<td>90.9</td>
<td>78.1</td>
<td>250</td>
</tr>
<tr>
<td>Copts</td>
<td>1.6</td>
<td>9.1</td>
<td>21.9</td>
<td>24</td>
</tr>
<tr>
<td>N of cases</td>
<td>122</td>
<td>88</td>
<td>64</td>
<td>274</td>
</tr>
<tr>
<td><strong>Coptic Workers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Alters' Religious Identity</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muslims</td>
<td>-</td>
<td>63.8</td>
<td>29.7</td>
<td>57</td>
</tr>
<tr>
<td>Copts</td>
<td>-</td>
<td>36.2</td>
<td>70.3</td>
<td>81</td>
</tr>
<tr>
<td>N of cases</td>
<td>-</td>
<td>47</td>
<td>91</td>
<td>138</td>
</tr>
</tbody>
</table>

**Notes:**
1- Chi-square test shows a significant relationship between percentage of alters' religion and percentage of Coptic workers in firms for both Muslim and Coptic workers.
2- For Muslim workers: Cramer's $V^2=0.280$ (significant).
3- For Coptic workers: Cramer’s $V=0.312$ (significant).
4- Calculations are based on non-relative alters to exclude the biasness towards creating ties with household members and relatives.

---

2 Cramer's $V$ is the most popular of the chi-square-based measures of nominal association, and it ranges between 0 and 1 regardless of table size. $V$ is the square root of chi-square divided by sample size, $n$, times $m$, which is the smaller of (number of rows - 1) or (number of columns - 1): $V = \sqrt{\chi^2/nn}$. 

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9.4.2 The Mutual Relationship between Social Segregation and Homophily Levels

A direct result of the Contact Hypothesis is the positive mutual relationship between social segregation and individuals' homophilous attitudes (expressed in Figure 9.2). A segregated social network would decrease the chance of intergroup contact, which increases homophily levels, and vice versa. On the other side, people with high homophily levels would be biased towards creating social relations with ingroup members and avoid outgroup members, even when contact occurs, and this would create homophilous social networks and increasing social segregation.

9.4.3 The Mutual Relationship between Workplace Segregation and Homophily Levels

In a similar way, segregated workplaces decrease the opportunity for intergroup contact which increases homophilous attitudes, and vice versa (Table 9.1 clearly supports this claim). On the other hand, individuals' homophily may affect workplace segregation through its effects on the exit patterns of workers and hiring discrimination.

Sørensen (2004) shows that the exit rates of workers are inversely related to the level of same-race representation at the time of organizational entry and increase when workers experience declines in same-race representation. Also, our empirical study shows similar results. As presented earlier in Table 7.11 in Chapter 7, Coptic workers tend to stay more than twice as long in workplaces with a higher percentage of Copts than in other workplaces (mean duration is 79.5 and 164.9 months respectively). However, as the number of Muslim friends increases in Copts' social networks (accompanied by a decreasing level of homophily), this difference in mean duration decreases and becomes insignificant. The mean duration of Muslim workers shows a
similar pattern (decreasing with increasing percentage of Coptic workers) though the differences in mean duration were not statistically significant.

Also, higher homophily levels among employers would promote hiring discrimination (Becker 1971), and this would increase workplace segregation. As presented earlier in Chapter 3 (Table 3.3), empirical data of WSIES survey (2005) confirms hiring discrimination in the Egyptian labour market. There is a strong tendency\(^3\) for Muslim and Coptic employers to hire workers of the same religion as their own.

### 9.4.4 The Mutual Relationship between Social and Workplace Segregation

Most of the research on workplace segregation emphasises one way of the relationship between social segregation and workplace segregation mediated by referral hiring (Elliott 2001, Tassier 2005, Tassier & Menczer 2005).

The conceptual model, in Figure 9.2, proposes that the relation between social segregation and workplace segregation can also go in the other direction. People spend a large fraction of their time at work, and that a large fraction of social interactions take place at workplaces (Grossetti 2005). When workplaces become segregated this reduces the chance for intergroup contact to occur, and this could affect social segregation directly (by reducing the chance for intergroup ties to develop) and indirectly (by increasing homophily levels which create biased against intergroup social relationships). Table 9.1 provides an empirical evidence for the positive correlation between social segregation and workplace segregation (without assuming any of the variables to be dependent or independent).

---

\(^3\) Eta correlation coefficient between Employers religious identity and percentage of Coptic workers in the firms was 0.718, which shows a high level of correlation.
9.5 Computerized Model Verification

Ensuring that the computer programming and implementation of the conceptual model are correct is not an easy task. It is very common to make programming errors, and sometimes these errors are not discovered until the model shows an unexpected behaviour (Gilbert & Troitzsch 2005). There are some general guidelines to reduce programming errors (which have been followed as far as possible during building the computerized model). For example, using a special-purpose simulation language (such as NetLogo which was used here) generally results in fewer errors than if a lower level programming language such as FORTRAN, C, or C++ is used. Similarly, using a structured and clear programming style (for example, informative variable names, proper indentation, and good documentation) reduces the probability of errors.

One of the most popular tests for model verification is the Extreme Condition Test (Sargent 2005), where the model is tested using a set of test cases, usually of extreme values for the parameters, where the outcomes are easily predictable (Gilbert & Troitzsch 2005). In the following, the Extreme Condition Test is applied to the computerized model. All model parameters are based on the values in Table 8.1 in Chapter 8 with modifications for each test case.

9.5.1 Extreme Condition 1: No Referral Hiring, No hiring Discrimination

In this extreme case, all hiring occurs randomly (referral-hiring = 0), and there is no hiring discrimination (hiring-discrimination-constant = 0). Figure 9.3 presents the results of the simulation model for these settings. In this case, as expected, levels of workplace and social segregation remain at very low levels. Random allocation of workers creates some segregation in workplaces and this would cause an equivalent level of social segregation to evolve. However, $G^A$, the measure of systematic
workplace segregation, is very close to zero, indicating a very low level of systematic (or intended) segregation. Also, under these settings (and in all the other test cases) both minority and majority groups have similar levels of unemployment (0.2 in the current example).

9.5.2 Extreme Condition 2: Complete Referral Hiring, No hiring Discrimination

In this second test case, all hiring occurs through insider referrals (\textit{referral-hiring} = 1), and there is no hiring discrimination (\textit{hiring-discrimination-constant} = 0). Figure 9.4 presents the results of the simulation model for these settings. Again, as expected in this case, significant levels of workplace and social segregation coevolve (average \(G=0.51\), average \(G'=0.25\), and average \(S=0.54\)). As in Extreme Condition 1, random allocation of workers to workplaces creates some level of workplace segregation and this promotes an equivalent level of social segregation. However, in this case and due to referral hiring, social segregation and workplace segregation start to reinforce each other pushing their levels higher than their values in case 1.
Figure 9.4: Emergence of workplace and social segregation for Extreme Condition 2 (complete referral hiring and no hiring discrimination).

9.5.3 Extreme Condition 3: All Social Links are Created at Random, Complete Referral hiring, hiring-discrimination-constant=1

As presented in Figure 9.5, because all links are created at random, there is almost no social segregation ($S=0.004$). The referral hiring and hiring discrimination promote a significant level of workplace segregation ($G=0.44$ and $G'=0.19$).
9.5 Operational Validation

During operational validation, the model's behaviour is tested against the observed empirical data derived from the Egyptian labour market and social networks. The observed levels of workplace segregation, social segregation, mean homophily levels of individuals, and unemployment levels of minority and majority groups are compared with simulated data. Three sources of data will be used to estimate model's parameters and measures: Workers' Status in Industrial Enterprises Survey (WSIES), Social Contract Survey (SCS), and the Empirical Data (ED) gathered by the researcher.

9.6.1 Estimating Model's Parameter for the Egyptian Case

Table 9.2 presents the estimated values for the model's parameters calculated from the three different sources of data.
Table 9.2: Estimated values for model’s parameters based on the empirical data.

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Parameter Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minority proportion ((P))</td>
<td>0.06</td>
<td>SCS</td>
</tr>
<tr>
<td>Overall unemployment rate</td>
<td>0.13</td>
<td>SCS</td>
</tr>
<tr>
<td>Number of workers</td>
<td>4800</td>
<td>Calculated 4</td>
</tr>
<tr>
<td>Number of firms</td>
<td>165</td>
<td>WSIES</td>
</tr>
<tr>
<td>Total number of jobs</td>
<td>4176</td>
<td>WSIES</td>
</tr>
<tr>
<td>Number of jobs in each firm</td>
<td>Same distribution as WSIES data</td>
<td>WSIES</td>
</tr>
<tr>
<td>Number of Coptic employers</td>
<td>14</td>
<td>WSIES</td>
</tr>
<tr>
<td>Number of Muslim employers</td>
<td>151</td>
<td>WSIES</td>
</tr>
<tr>
<td>Level of referral hiring</td>
<td>0.65</td>
<td>ED</td>
</tr>
<tr>
<td>Probability of creating new</td>
<td>0.3, 0.5, 0.01 (respectively)</td>
<td>ED</td>
</tr>
<tr>
<td>links through work, social</td>
<td></td>
<td></td>
</tr>
<tr>
<td>network, and randomly.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum network size</td>
<td>Normal ((8,4))</td>
<td>ED</td>
</tr>
</tbody>
</table>

9.8.2 Comparing Observed and Simulated Results

Table 9.3 shows that there a great level of similarity between the observed values of the variables and the simulated values. All of the confidence intervals (CI’s) of the difference between of the observed and simulated values contain the zero point, indicating that the values are not statistically different.

4 Calculated based on number of jobs and unemployment rate.
Table 9.3: Comparing observed and simulated values of the simulation model.

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Observed Value</th>
<th>Source</th>
<th>Simulated Value</th>
<th>Std. Error</th>
<th>95% Confidence Interval for Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Segregation</td>
<td>0.802</td>
<td>ED</td>
<td>0.796</td>
<td>0.004</td>
<td>(-0.013, 0.001)</td>
</tr>
<tr>
<td>Workplace Segregation - Gini</td>
<td>0.932</td>
<td>WSIES</td>
<td>0.925</td>
<td>0.003</td>
<td>(-0.0136, 0.0002)</td>
</tr>
<tr>
<td>Muslims unemployment</td>
<td>0.133</td>
<td>SCS</td>
<td>0.1334</td>
<td>0.0002</td>
<td>(-0.0008, 0.0009)</td>
</tr>
<tr>
<td>Copts unemployment</td>
<td>0.079</td>
<td>SCS</td>
<td>0.074</td>
<td>0.003</td>
<td>(-0.011, 0.002)</td>
</tr>
</tbody>
</table>

9.7 Chapter Conclusion

In this chapter the processes of model validation and verification were discussed. The methodology used for validation and verification of the proposed model of segregation that has been developed in the previous chapter was discussed.

Various relations in the conceptual model were validated based on empirical data, including the Contact Hypothesis, the mutual relationship between social segregation and homophily levels, the mutual relationship between workplace segregation and homophily levels, and the mutual relationship between social and workplace segregation.

The computerised model was validated based on three extreme condition tests:

1. No Referral Hiring, No hiring Discrimination
2. Complete Referral Hiring, No hiring Discrimination
3. All Social Links are Created at Random, Complete Referral hiring, hiring-discrimination-constant=1
Finally, for operational validation, the model's behaviour was tested against the observed empirical data driven from the Egyptian labour market and social networks. There was a great similarity between the observed values of the variables and the simulated values.
10 EXPERIMENTING WITH THE MODEL

10.1 Aims of This Chapter

In this chapter, the model that has been developed and validated in earlier chapters will be used in some experiments. The objective is to study the effects of the following factors on social and workplace segregation:

- Unemployment level (Section 10.2)
- Size of social networks of agents (Section 10.3)
- Hiring discrimination (Section 10.4)
- Size of minority group (Section 10.5)
- Firms' sizes (Section 10.6)

10.2 The Relationship between Unemployment Level and Segregation

In this section, the effect of the overall unemployment level on social and workplace segregation is examined. Most of the literature on the relationship between segregation and unemployment focuses on the effects of workplace and occupational segregation on employment and wage inequality (For example, Carrington & Troske 1998, Glass 1990, Tassier & Menczer 2005). There is almost no research on the effect of overall unemployment levels on social and workplace segregation. This is because there is little suitable empirical data. Unemployment levels usually change very slowly and within narrow margins, so it is very difficult to have longitudinal data about social and workplace segregation and levels of unemployment for one society.
Here, experimenting using simulation models seems to be a good (and may be the only) choice. Firstly, the design of the simulation experiment is introduced and then the simulation results.

10.2.1 Experiment Design

In this experiment, the model parameters were estimated using the three empirical studies (as described earlier in the Chapter 6): Workers' Status in Industrial Enterprises Survey (WSIES), Social Contract Survey (SCS), and the Empirical Data (ED) gathered by the researcher. Table 10.1\(^1\) presents the values of these parameters.

The model was run\(^2\) for some experimental levels of unemployment rate (0, 0.2, 0.4, 0.6 and 0.8), and for each level the number of workers is calculated by dividing the number of jobs (4176) by (1-unemployment rate).

\(^1\) Table 10.1 was copied from Table 9.2 in the previous chapter for the convenience of the reader.

\(^2\) All experiments in this chapter are based on 30 runs for 500 time steps each.
Table 10.1: Estimated values for model’s parameters based on the empirical data.

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Parameter Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minority proportion ($P$):</td>
<td>0.06</td>
<td>SCS</td>
</tr>
<tr>
<td>Overall unemployment rate</td>
<td>0.13</td>
<td>SCS</td>
</tr>
<tr>
<td>Number of workers</td>
<td>4800</td>
<td>Calculated</td>
</tr>
<tr>
<td>Number of firms</td>
<td>165</td>
<td>WSIES</td>
</tr>
<tr>
<td>Total number of jobs</td>
<td>4176</td>
<td>WSIES</td>
</tr>
<tr>
<td>Number of jobs in each firm</td>
<td>Same distribution as WSIES data</td>
<td>WSIES</td>
</tr>
<tr>
<td>Number of Coptic employers</td>
<td>14</td>
<td>WSIES</td>
</tr>
<tr>
<td>Number of Muslim employers</td>
<td>151</td>
<td>WSIES</td>
</tr>
<tr>
<td>Level of referral hiring</td>
<td>0.65</td>
<td>ED</td>
</tr>
<tr>
<td>Probability of creating new links through work, social network, and randomly.</td>
<td>0.3, 0.5, 0.01 (respectively)</td>
<td>ED</td>
</tr>
<tr>
<td>Maximum network size</td>
<td>Normal (8,4)</td>
<td>ED</td>
</tr>
</tbody>
</table>

10.2.2 Experiment Results

As presented in Figure 10.1, both social segregation and workplace segregation tend to increase with increasing level of unemployment until it reaches some level (0.2 in Figure 10.1), after which increasing unemployment level has no effect on social and workplace segregation.

With lower levels of unemployment, employers might not have enough referrals from current incumbents (since most alters in their social networks would have jobs already). In this case, according to the suggested model, employers might hire

---

3 Calculated based on number of jobs and unemployment rate.
workers formally (that is, randomly), which would decrease workplace segregation and consequently decrease social segregation. However, this positive effect of unemployment on segregation levels vanishes at some point (0.2 in the current experiment) when most of the working agents are linked to at least one unemployed agent for whom they can give referrals.

Referring to Egypt’s case (with unemployment rate 0.13), the results of this experiment suggest that the Egyptian society could be less segregated if the unemployment level decreases (of course in addition to other positive social and economical effects).

Figure 10.1: The effect of unemployment level on workplace and social segregation.
10.3 Size of Social Networks

In this experiment, the hypothesis being tested is that increasing the average size of individuals' social networks would decrease social and workplace segregation.

10.3.1 Experiment Design

The simulation model was run using the parameters in Table 10.1 except that the mean size of social networks was varied between 5 and 30 (as presented in Figure 10.2). It was difficult to extend the experiment to mean network sizes greater than 30 because of limitations on the computational resources available, since the computational time was found to increase exponentially with increasing mean network size.

10.3.2 Experiment Results

The results presented in Figure 10.2 show that there is a negative relationship between the mean size of individuals' social networks and social and workplace segregation. With increasing network size the probability for individuals to have social links to others from different social group increases, hence social and workplace segregation would decrease (according to the Contact Hypothesis discussed earlier in Section 2.3.1).
10.4 Hiring Discrimination

As described earlier in Chapter 8, hiring discrimination for a firm $f$, $D_f$, was defined to be the product of discrimination-constant by mean homophily level of workers, where discrimination-constant indicates to what extent homophily attitudes of employers are translated into actual hiring discrimination. Laws or rules, such as affirmative action which intends to promote the access of unprivileged groups to employment, might restrict an employer's ability to discriminate against some social group(s). In this case, the value of the discrimination-constant would be relatively low. In this section, the effect of this discrimination-constant on social and workplace segregation level is investigated.

10.4.1 Experiment Design

As with the previous two experiments, the simulation model was run using the parameters in Table 10.1 while varying the level of discrimination-constant between 0 and 1.

---

Figure 10.2: The effect of average size of social networks on segregation.
10.4.2 Experiment Results

The simulation results presented in Figure 10.3 show that there is a strong positive relationship between hiring discrimination (through discrimination-constant) and social and workplace segregation. A complete segregation in workplaces would occur when the discrimination-constant is one.

Reflecting on data about the Egyptian society, the estimated value of discrimination-constant is relatively high, and this would suggest that there is a great potential in reducing social and workplace segregation when adopting suitable anti-discrimination laws.

![Segregation Indexes](image)

**Figure 10.3:** The effect of hiring discrimination on segregation.

10.5 Minority Proportion

In this experiment, the hypothesis being tested is that increasing the proportion of the minority group would decrease social and workplace segregation.
10.5.1 Experiment Design

As presented in Table 10.2, the simulation model was run using values for the minority proportion between 0.1 and 0.5. Using values for the minority proportion different than that of Egypt's data (0.06) required a change in the distribution of firms and workers as well because the numbers of Coptic and Muslim employers need to be consistent with the value of the minority proportion used in the experiment. So, the simulation was run using 100 firms each having 25 jobs (the same as the mean number of jobs in WSIES).

Table 10.2: Model's parameters used to study the effect of minority proportion on segregation.

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Parameter Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minority proportion ($P$):</td>
<td>0.1, 0.2, 0.3, 0.4, 0.5</td>
<td>Experimental Values</td>
</tr>
<tr>
<td>Overall unemployment rate</td>
<td>0.13</td>
<td>SCS</td>
</tr>
<tr>
<td>Number of workers</td>
<td>2500</td>
<td>Calculated</td>
</tr>
<tr>
<td>Number of firms</td>
<td>100</td>
<td>Arbitrary</td>
</tr>
<tr>
<td>Number of jobs in each firm</td>
<td>25</td>
<td>WSIES</td>
</tr>
<tr>
<td>Number of Coptic employers</td>
<td>Minority proportion * Number of firms</td>
<td>Calculated</td>
</tr>
<tr>
<td>Number of Muslim employers</td>
<td>(1-Minority proportion) * Number of firms</td>
<td>Calculated</td>
</tr>
<tr>
<td>Discrimination-constant</td>
<td>0.7</td>
<td>WSIES</td>
</tr>
<tr>
<td>Level of referral hiring</td>
<td>0.85</td>
<td>ED</td>
</tr>
<tr>
<td>Probability of creating new links</td>
<td>0.3, 0.5, 0.01 (respectively)</td>
<td>ED</td>
</tr>
<tr>
<td>Maximum network size</td>
<td>Normal (8,4)</td>
<td>ED</td>
</tr>
</tbody>
</table>
10.5.2 Experiment Results

As Figure 10.4 shows, there is a negative relationship between minority proportion and social and workplace segregation. With increasing minority proportion the probability for individuals to have social links to others from different social group increases, and this decreases social and workplace segregation. The minority proportion also affects the level of segregation at the initial stages of the simulation. As described earlier in Chapter 3, mere random allocation of workers to jobs, during the initial stages of simulation, would create some level of workplace segregation, and this level increases as the minority proportion decreases.

10.6 Firms' Sizes

Many empirical studies suggest that there is negative relationship between a firm size and workplace segregation (for example, Holzer 1996, Sørensen 2004). Most of these studies argue that large firms may be less segregated because they are subject to more regulations and oversight regarding hiring practices. Smaller firms are less
likely to have formal human resources departments than larger firms, so they rely heavily on less costly informal recruitment channels. These informal recruitment methods create greater disadvantages for minority groups.

However, the main concern of the current simulation experiment is to study how firm size affects social and workplace segregation according to the suggested dynamic framework. In other words: would this negative relationship with firm size still exist even when all firms follow the same hiring practices?

10.6.1 Experiment Design

The simulation model was run using the parameters in Table 10.2 but with firm size (Number of jobs in each firm) ranging from 10 to 90. For each simulation run, the number of firms is calculated as: total number of jobs (2500) divided by firm size.

![Figure 10.5: The effect of average firm size on segregation.](image)
10.6.2 Experiment Results

As presented in Figure 10.5, the simulation results show that there is a strong negative relationship between average firm size and social and workplace segregation even when all firms are assumed to follow the same hiring practices. This negative relationship could be explained by two factors. Firstly, increasing the average firm size would decrease levels of segregation at the initial stages of simulation (in exactly the same way as minority proportion increases). Secondly, increasing the firm size would increase the probability for some firm to have workers from different social groups proportionally represented inside this firm, which increases the probability for social links to be established among these workers, and this would decrease social segregation and workplace segregation.

10.7 Chapter Conclusion

In this chapter, the simulation model was used in a number of experiments. The results of the experiments showed that:

- There is a positive relationship between the overall unemployment level and segregation. Both social and workplace segregation increase with an increase of unemployment.
- A weak negative relationship was found between the average individuals’ network size and segregation.
- Hiring discrimination was strongly and positively correlated with both social and workplace segregation.
- The relationship between minority proportion and segregation is a strong negative one.
- Finally, both social and workplace segregation are negatively correlated with the average firm size.
11 CONCLUDING SUMMARY

11.1 Introduction

The main impetus of the current thesis is to understand why the social distance between Copts and Muslims has been increasing and why their social networks and workplaces are getting more segregated. Segregation is a complex concept that has many dimensions and many sources. Segregation could happen in individuals' social networks, neighbourhood, and/or in organizations such as schools, universities, places of worship (e.g. churches and mosques in the Egyptian case), and workplaces. Most previous research on segregation has focused mainly on the consequences rather than the determinants of segregating, and studied each of these sources separately. For example, some research focused on residential segregation, some focused on segregation in schools or universities, and so on. The original aim of this thesis was to study the determinants of segregation, how it emerges and how these different sources of segregation are interrelated. However, because of limited resources, the research focused on two important dimensions of segregations: social networks and workplaces (as a proxy for organizations).

11.2 Objectives

The general objective of the current research was to develop an agent-based model that describes and explain the co-emergence of social and workplace segregation. Models are helpful tools to simplify and understand complex social systems and phenomena such as social and workplace segregation.
The model was used as an investigation tool to study the relationship between segregation and: (1) referral hiring, (2) unemployment rate, (3) sizes of social networks, (4) hiring discrimination, (5) proportion of the minority group, (6) Firm size (number of workers in the firm), and (7) employment inequality between majority and minority groups.

11.3 Methods

Statistical analysis and agent-based modelling have been used in an integrated way to achieve the research objectives. A general framework has been proposed that describes the dynamic mutual relationships between social segregation, workplace segregation, mean homophily level, and referral hiring. This framework served as a conceptual model that helped to identify the data to be collected and guided the statistical analysis and development of the agent-based model.

11.3.1 Data Sources

Three data sources, about the labour market and social networks in Egypt, have been used to achieve the objectives of the current thesis:

- The Social Contract Survey (SCS) was used to estimate the overall proportion of Copts and unemployment rates for Muslims and Copts.
- The Workers' Status in Industrial Enterprises Survey (WSIES) was used to estimate the level of workplace segregation. Also, the firms in WSIES served as a frame to select employers and workers for the further in-depth interviews.
- Structured face-to-face interviews were carried out with 39 employers (27 Muslims and 12 Copts) and 122 workers (81 Muslims and 41 Copts) in four Egyptian governorates during August and September 2007. These data
provided information about social networks for Copts and Muslims and enabled the measurement of social segregation.

11.3.2 The Agent-Based Model

The agent-based modelling approach has been used as the main research method, along with statistical analysis. An agent-based model has been developed (based on the results of empirical sources of data) to investigate the co-emergence of social and workplace segregation, and to identify the main determinants of these sources of segregation.

The model creates an artificial labour market and society where agents (people) use their social networks to search for jobs. Agents change their social networks by creating new social relationships (links) with other agents while some other links dissolve. The composition of workplaces also may change through the processes of workers' firing and hiring.

The model has been validated at the conceptual level and at the data level, and there was a great similarity between the simulated and the observed results.

11.4 Main Research Findings

The main contribution of the current thesis is modelling the co-emergence of social and workplace segregation. Creating a model for these phenomena enables better understanding of the underlying mechanisms of segregation and its determinants. The model can be used as an experimental tool to test further theories and hypotheses about segregation. Although the model is validated against data from the Egyptian society, it can be used, with proper estimation of model's parameters, to capture different societies and social contexts (e.g., less privileged minorities). Some
of the main results of the empirical data, and results from simulation experiments are discussed in the following.

11.4.1 Levels of Segregation

The analysis of the WSIES data provided evidence for high levels of workplace segregation. The Gini index of workplace segregation was 0.932. The dissimilarity index was also computed, $D=0.825$, which means that about 83 percent of the Coptic (or Muslim) workers would have to change their workplace in order to attain a complete integration at Egyptian workplaces.

The empirical study showed that there is a high level of segregation based on religion in the social networks of Muslims and Copts: the index of social segregation, $S$, was 0.902.

The SCS data confirmed the formal announced proportion of Copts which is around 6 percent of the Egyptian population, and showed that Copts are not evenly distributed among regions and governorates in Egypt. They concentrate in Upper Egypt more than Lower Egypt, and tend to be overrepresented in some areas inside the same governorate. Another result from the SCS is that Muslims have a higher unemployment rate (13.3 percent) than Copts (8.0 percent).

11.4.2 Labour Market and Discrimination

The data from the interviews with the employers and workers showed that:

- Informal search for jobs using friends and relatives is common, and was used to secure about 58 percent of jobs for workers. There was also a high level of segregation in job contacts, that is, Copts and Muslims are more likely to refer or pass job information to others of the same religion as their own.
There is evidence of hiring discrimination from both Coptic and Muslim employers. A high correlation was found between employers' religion and the proportion of Copts in the workplace.

Evidence was also found of discrimination from the workers' side (especially Muslim workers). For example, one quarter of Muslim workers reported that it is important for them to work with a Muslim employer, and 8 percent prefer to work with other Muslim workmates. Half of workers, Muslims and Copts, believe that employers tend to hire workers of the same religion as their own.

Exit patterns play an important role in segregation. For example, on average, Coptic workers tend to stay more than twice as long in workplaces with a high percentage of Copts than in other workplaces (165 versus 80 months respectively).

11.4.3 Social Networks

The interviews with the workers showed that social networks measures are similar for Muslims and Copts:

- The network size (based on the adopted definition of a social network) ranges from 2 to 20 persons with an average of 7.1.
- There is a high level of density and overlap in social relations. Around 72 percent of alters of an ego have social relationships between each other, and 65 percent of them have intimate/strong relationships.
- Families and workplaces are the main source of social relationships. More than half the social relations were found to be with relatives, about 26 percent with workmates, 10 percent with neighbours, 4 percent with previous school/university colleagues, and other sources (mainly through other friends and mosques/churches).
11.4.4 Results of the Agent-Based Model

The simulation model has been used in some experiments, and the results of these experiments showed that:

- A labour market may experience significant levels of workplace segregation and social segregation even when the hiring of workers occurs mainly through formal channels.
- Referral hiring may be beneficial for the employment of minority groups especially when the population is highly segregated. The relationship between referral hiring and minority unemployment is curvilinear with a U-shape.
- Majority-group members tend to be more homophilous than minority-group members.
- Referral hiring is an important determinant of social and workplace segregation.
- Hiring discrimination was strongly, and positively correlated with both social and workplace segregation.
- There is a positive relationship between the overall unemployment rate and segregation.
- A weak negative relationship was found between the average individuals' network size and segregation.
- The relationship between minority proportion and segregation is a strongly negative one.
- An average firm size is negatively correlated with social and workplace segregation.
The results the simulation model showed that some level of segregation based on religion is inevitable even if Muslims and Copts are completely egalitarian. The main source of social relationships is the family which is, in most cases, a segregated social entity. Members of the same family are mostly of the same religion. However, segregation can be limited by encouraging integration in organizations such as workplaces, schools, charity societies, and social clubs.

As the empirical data and the results of the simulation model showed, hiring discrimination was the most influential and controllable variable (unlike network size, firm size, and minority proportion which can not be controlled) affecting workplace segregation. Thus, encouraging employers to adopt formal hiring and equal-opportunity recruitment would decrease workplace segregation and, consequently, social segregation. For example, with zero discrimination, the modified Gini index of workplace segregation would decrease from its current level of 0.9 to 0.2 and social segregation would decrease from 0.8 to 0.5.

11.5 Directions for Future Research

The current work can be extended in many ways:

- A more general model may be needed to incorporate more dimensions and sources of segregation in addition to social networks and workplaces. For example, an important source of segregation is neighbourhood. A model that takes into consideration spatial configurations of different social group would be useful.

- The model can be extended by considering different social network structures, especially at the initial stage of simulation. Only a random network model has been used in the current model.
The model can also be extended to consider multicultural societies with more than two social groups, for example, UK and US.
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Appendix A: Employer Questionnaire
SOCIAL NETWORKS AND EMPLOYMENT SURVEY

Employer Questionnaire

August 2007

ALL DATA WILL BE KEPT CONFIDENTIAL AND WILL BE USED FOR SCIENTIFIC PURPOSES ONLY
Hello, My name is ____________. We are conducting this survey about employment, social networks and religion. I would very much appreciate your participation in the survey. I would like to ask you about your experience and practices as an employer regarding recruiting new workers for your firm. The survey usually takes about 15 minutes to complete. Whatever information you provide will be kept strictly confidential and will not be shown to any other persons.

Participation in the survey is voluntary and you can choose not to answer any of the questions or withdraw from participation at any time. However, I hope that you will participate in the survey since your views are important.

At this time, do you want to ask me anything about the survey?

May I begin the interview now?

SIGNATURE OF INTERVIEWER: _______________________

RESPONDENT AGREES TO INTERVIEW ☐  RESPONDENT DOES NOT AGREE ☐

PROCEED WITH INTERVIEW... RECORD REASON AND STOP

<table>
<thead>
<tr>
<th>IDENTIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME OF RESPONDENT: .................................................................</td>
</tr>
<tr>
<td>POSITION IN THE FIRM: .................................................................</td>
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<tr>
<td>FIRM: ...............................................................................................</td>
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<tr>
<td>ADDRESS IN DETAIL: ...........................................................................</td>
</tr>
<tr>
<td>GOVERNORATE: ..................................................................................</td>
</tr>
<tr>
<td>KISM: .................................................................................................</td>
</tr>
<tr>
<td>SHIAKHA: ............................................................................................</td>
</tr>
<tr>
<td>INTERVIEWER: ....................................................................................</td>
</tr>
<tr>
<td>DATE OF INTERVIEW: ............../............../2007</td>
</tr>
<tr>
<td>TIME OF INTERVIEW: ...........................................................................</td>
</tr>
<tr>
<td>REQUIRED NUMBER OF WORKERS FOR INTERVIEW: ................................</td>
</tr>
<tr>
<td>MUSLIM WORKERS: ...............................................................................</td>
</tr>
<tr>
<td>COPTIC WORKERS: ...............................................................................</td>
</tr>
</tbody>
</table>
SECTION 1: WORKERS' TURNOVER

I would like to ask you about some of the workers who were working here when we visited this firm two years ago.

<table>
<thead>
<tr>
<th>NO</th>
<th>NAME</th>
<th>Is (NAME) still working here?</th>
<th>When had he left the firm?</th>
<th>Why had he left the firm?</th>
<th>For how long has/had (NAME) been working here?</th>
<th>Is (NAME) Muslim or Copt?</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td></td>
<td>YES 1 NO 2</td>
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<td>02</td>
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<td>YES 1 NO 2</td>
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<td>03</td>
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<td>YES 1 NO 2</td>
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<td>04</td>
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<td>YES 1 NO 2</td>
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<td>05</td>
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<td>YES 1 NO 2</td>
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<td>YES 1 NO 2</td>
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<td>07</td>
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<td>YES 1 NO 2</td>
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<td>08</td>
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<td>YES 1 NO 2</td>
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<td>09</td>
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<td>YES 1 NO 2</td>
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<td>YES 1 NO 2</td>
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<td>YES 1 NO 2</td>
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<td>YES 1 NO 2</td>
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<td>13</td>
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<td>YES 1 NO 2</td>
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<td>14</td>
<td></td>
<td>YES 1 NO 2</td>
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<tr>
<td>15</td>
<td></td>
<td>YES 1 NO 2</td>
<td></td>
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</tr>
</tbody>
</table>

1 CODES FOR Q104: 1-He found another job 2- He was not happy with the salary 3-He was not good at his job 4-His behaviour was not good 5-He was no longer needed 6-Other reasons (SPECIFY)
SECTION 2: SELECTION OF WORKERS FOR INTERVIEWS

<p>| | | | | | |</p>
<table>
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</thead>
<tbody>
<tr>
<td>201</td>
<td>In what year have you started working in this firm?</td>
<td>YEAR:</td>
<td></td>
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<tr>
<td>202</td>
<td>How many workers did you have then?</td>
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<td>203</td>
<td>How many of them were Copts?</td>
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</tr>
<tr>
<td>204</td>
<td>How many workers do you have now?</td>
<td></td>
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</tr>
<tr>
<td>205</td>
<td>How many of them are Copts?</td>
<td></td>
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</tr>
</tbody>
</table>

We would like to make some interviews with workers in your firm, and this will be in their homes and with their approval. Could you please give me names and address of three of the most recent Muslim workers (and three of the most recent Coptic workers) for interview?

<table>
<thead>
<tr>
<th>NO</th>
<th>NAME</th>
<th>For how long has (NAME) been working here?</th>
<th>In (NAME) Muslim or Copt?</th>
<th>LINE NUMBER (0100)</th>
<th>SELECTED FOR INTERVIEW?</th>
<th>IF SELECTED FOR INTERVIEW: ADDRESS IN DETAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(MONTHS)</td>
<td>M</td>
<td>C</td>
<td>YES</td>
<td>NO</td>
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<td></td>
<td></td>
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<td>2</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
### SECTION 3: RECRUITMENT ATTITUDES AND PRACTICES

#### 301 When you want to hire a new worker, which of the following methods you may use? And how frequently?

<table>
<thead>
<tr>
<th>Method</th>
<th>Frequently</th>
<th>Sometimes</th>
<th>Rarely</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make an advertisement/Ask employment agency</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Ask one of current workers to look for one for you</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Ask one of your friends to look for one for you</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Look for someone you know before</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Other methods (SPECIFY)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

#### 302 Generally, which workers, Coptic or Muslim, do you think are better than the others in each of the following:

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Muslims</th>
<th>Copts</th>
<th>The Same</th>
<th>DK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work harder</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>More honest</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>More cooperative with managers/supervisors</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>More cooperative with other workmates</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Respect work rules (e.g. coming and leaving in time)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Accept lower salary</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

#### 303 How important or not important, you think, is it for you to work with workers of the same religion as yours?

- Very important: 1
- Important: 2
- Neutral: 3
- Not important: 4
- Not important at all: 5

#### 304 IF IMPORTANT/VERY IMPORTANT:

- Why?

#### 305 How good or bad thing, you think, is it to have workers with different religions in the same workplace?

- Very good: 1
- Good: 2
- Neutral: 3
- Bad: 4
- Very bad: 5

#### 306 IF NOT NEUTRAL:

- Why?

#### 307 How strongly do you agree or disagree that Muslims tend to employ each others more than employing Copts?

- Strongly agree: 1
- Agree: 2
- Neutral: 3
- Disagree: 4
- Strongly disagree: 5
<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>308 How strongly do you agree or disagree that Copts tend to employ</td>
<td>STRONGLY AGREE: 1  AGRE: 2  NEUTRAL: 3  DISAGREE: 4  STRONGLY DISAGREE: 5</td>
</tr>
<tr>
<td>others more than employing Muslims?</td>
<td></td>
</tr>
<tr>
<td>309 How strongly do you agree or disagree that there is discrimination</td>
<td>STRONGLY AGREE: 1  AGRE: 2  NEUTRAL: 3  DISAGREE: 4  STRONGLY DISAGREE: 5</td>
</tr>
<tr>
<td>against Copts in Egypt?</td>
<td></td>
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<tr>
<td>310 IF AGREE/STRONGLY AGREE:</td>
<td></td>
</tr>
<tr>
<td>In what way?</td>
<td></td>
</tr>
<tr>
<td>311 What is your year of birth?</td>
<td>YEAR:</td>
</tr>
<tr>
<td>312 What is the highest level of education you finished?</td>
<td>NO EDUCATION AT ALL: 1  PRIMARY: 2  PREPARATORY: 3  SECONDARY: 4  UPPER INTERMEDIATE: 5  UNIVERSITY/HIGHER: 6</td>
</tr>
<tr>
<td>313 Are you Muslim or Copt?</td>
<td>MUSLIM: 1  COPT: 2</td>
</tr>
<tr>
<td>314 RECORD TIME:</td>
<td></td>
</tr>
<tr>
<td>315 THANK THE RESPONDENT FOR PARTICIPATION, REASSURE</td>
<td>VERY GOOD: 1  GOOD: 2  MODERATE: 3  BAD: 4  VERY BAD: 5</td>
</tr>
<tr>
<td>CONFIDENTIALITY, AND RECORD DEGREE OF COOPERATION:</td>
<td></td>
</tr>
<tr>
<td>RECORD ANY NOTES:</td>
<td></td>
</tr>
</tbody>
</table>
Arabic Version
مسح العلاقات الاجتماعية والتوظيف

استمارة صاحب العمل

اغسطس 2007

بيانات هذا المسح سرية ولن تستخدم في غير أغراض البحث العلمي
الموافقة على الاشتراك في الدراسة

أعلا، أنا اسمي ...، أرجو أن يتم التعامل بانتباه والتفاني في المقابلات والتحقيقات والمناقشات والذهاب إلى القسم المقابل، حتى نتمكن من العمل بشكل متناغم وفعال. أرجو أن يتم التعامل بشكل مثالي وفعال، حتى نتمكن من العمل بشكل متناغم وفعال.

إذا انتهت المقابلة، يرجى إكمال المعلومات المطلوبة.

من فضلك، لا تنسى أنك مدعو للقاء، ونأمل أن نتمكن من العمل بشكل مثالي.

إحدى المقابلات

الموافق:  

المستجيب:  

سجل:  

تاريخ المقابلة:  

قبل المقابلة:

الموافق:

المستجيب:  

سجل:  

تاريخ المقابلة:  

قبل المقابلة:

الموافق:

المستجيب:  

سجل:  

تاريخ المقابلة:  

قبل المقابلة:

الموافق:

المستجيب:  

سجل:  

تاريخ المقابلة:  

قبل المقابلة:
القسم الأول: دوران العمل

في بداية أحب أسأل حضرتك عن بعض العمل الذي كانوا شغفًا هنا لما زارنا المنشأة من سكين

| إذا كان العمل ترك العمل | ولًا كيفي؟ | مسلم | غير مسلم | في المجتمع؟ | ماذا يكون من الاسم؟  
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</tbody>
</table>

القسم الثاني: اختر العمل المقابلة الفردية

<table>
<thead>
<tr>
<th>في أي سنة بدأت العمل في المنشأة؟</th>
<th>201</th>
</tr>
</thead>
<tbody>
<tr>
<td>وكان عندك كام عمل في المنشأة وقت ما بدأت النشاط؟</td>
<td>202</td>
</tr>
<tr>
<td>كام واحد منهم كان قبطي؟</td>
<td>203</td>
</tr>
<tr>
<td>واللوكي عندك كام عمل في المنشأة؟</td>
<td>204</td>
</tr>
<tr>
<td>كام واحد منهم قبطي؟</td>
<td>205</td>
</tr>
</tbody>
</table>

**التعليم وظيفة أخرى**

1. لم يكن جيدًا/واها في عمله
2. لم يكن عندك حماية في العمل
3. لم يكن جيدًا/واها في عمله
4. لم يكن عندك حماية في العمل
5. لم يكن جيدًا/واها في عمله
6. لم يكن عندك حماية في العمل

![Diagram](image)
أحداً عازرين نعمل مقابلاً مع بعض العمال في المشاة، والمقابلة دي هكنيف في بيت العامل ولهكون مواقفه طباً، ممكن بعد ذاك، تملي أسماً ثلاثة من العمال
المسلمين الذين اشتفاً جدًى في المشاة (رساء ثلاثة من العمال الألفين) عنوان تفاصيلهم؟

<table>
<thead>
<tr>
<th>الأسم</th>
<th>لواء السمل (ف.و.م)</th>
<th>مسلم قبطي</th>
<th>مسلم (ولادي قلبي)</th>
<th>مسلم (ولادي قلبي)</th>
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القيمة الثالثة: الاتجاهات وأجراءات التوظيف

لما حسب تجربة عمل كيف يستخدم كيف من الطرق التي هكزها كليو، فكل العملي؟

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بلديم عمدة في رايك من أفضل في الشغل في الحاجات التي هلاءناها على العمل المسلم، ولا

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إلى أي مدى مهم أو مس المهم بالنسبة لك فاك تتشغل مع عمال يكون فيهم نفس الديانة بناية

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<th>غير مهم على الإطلاق</th>
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إلى أي مدى تعتقد أو لا تعتقد إن الآلفًا يبحروا ويشلون مسلمين مسلمين زئبهم أكثر من الآلفًا؟

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إذا كانت الإجابة اعتقدي/اعتقد جدًا، فإليك السؤال التالي:

حضرتك مومياء سنة كم؟

وكم هو العمر الذي يليه حضرتك؟

وبحضرتك مومياء ولا قطاعي؟

سجل وقت انتهاء المقابلة:

شكرًا للإجابة، وأعد تأكيد أن البيانات سرية.

سجل درجة تعاون المستجيب

إلى أي مدى تعتقد أو لا تعتقد إن المسلمين يبحروا ويشلون مسلمين مسلمين زئبهم أكثر من

إلى أي مدى تعتقد أو لا تعتقد إن الآلفًا يبحروا ويشلون مسلمين مسلمين زئبهم أكثر من

إلى أي مدى تعتقد أو لا تعتقد إن الآلفًا يبحروا ويشلون مسلمين مسلمين زئبهم أكثر من

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Appendix B: Worker Questionnaire
Hello, My name is ___________. We are conducting this survey about employment, social networks and religion. I would very much appreciate your participation in the survey. I would like to ask you about your work experience and your social network. The survey usually takes about 30 minutes to complete. Whatever information you provide will be kept strictly confidential and will not be shown to any other persons.

Participation in the survey is voluntary and you can choose not to answer any of the questions or withdraw from participation at any time. However, I hope that you will participate in the survey since your views are important.

At this time, do you want to ask me anything about the survey?

May I begin the interview now?

SIGNATURE OF INTERVIEWER: ___________

RESPONDENT AGREES TO INTERVIEW ☐  RESPONDENT DOES NOT AGREE ☐

PROCEED WITH INTERVIEW...  RECORD REASON AND STOP

IDENTIFICATION

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### SECTION 1: RESPONDENT'S BACKGROUND AND HOUSEHOLD COMPOSITION

**PLEASE LIST ALL YOUR HOUSEHOLD MEMBERS, STARTING WITH YOURSELF:**

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<th>NAME</th>
<th>What is your relationship to (NAME)?</th>
<th>M</th>
<th>F</th>
<th>What is the age of (NAME)?</th>
<th>What is the highest level of education of (NAME)?</th>
<th>Is (NAME) currently attending school/university?</th>
<th>What is the marital status of (NAME)?</th>
<th>Is (NAME) currently working or not?</th>
<th>NOT CURRENTLY ATTENDING SCHOOL: Is (NAME) in the same line of work as yours?</th>
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SECTION 2: RESPONDENT'S SOCIAL NETWORK

NOW, WE WOULD LIKE TO KNOW SOME INFORMATION ABOUT YOUR SOCIAL NETWORK.

FOR QUESTIONS 201-208:
Give a new number for each person mentioned by respondent. If respondent mentioned the same person in more than one question, then write the same first number given to the person along with his/her name. Start numbering after the last HH member of Section 1.

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>201</td>
<td>From time to time, most people discuss important matters with other people. Who are the people with whom you discuss matters important to you?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PROBE: Any body else?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>202</td>
<td>Who from outside your household has recently helped you with tasks around the home, such as painting, moving furniture, cooking, cleaning or major or minor repairs?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PROBE: Any body else?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>203</td>
<td>Suppose you need to borrow some small thing like a tool or a cup of sugar, from whom outside your household would you ask to borrow it?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PROBE: Any body else?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>204</td>
<td>If you need to borrow a large sum of money, say LE1000, whom would you ask for help?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PROBE: Any body else?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>Description</td>
<td>Probe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
<td>-------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>205</td>
<td>Who are the people you really enjoy socializing with? For example: people with whom you may have lunch or dinner together, you may exchange home visits, or you may meet outside the home for recreation (e.g. restaurant, coffee shop, park, club, etc.).</td>
<td>Any body else?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>206</td>
<td>With whom would you talk about your work? For example: decisions you have to make, professional problems you have to solve and ways to improve how you work?</td>
<td>Any body else?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>207</td>
<td>If you are going to search for a new job, whom would you ask for information or help about that?</td>
<td>Any body else?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 208 | Are there any other persons that are close to you that have not been mentioned in one of the previous questions? | NO……………………………….1 
YES (GIVE LIST BELOW)…………………………..2 
IF YES: Who are they? |

**FOR QUESTIONS 209-221:**
Write down all the numbers (Q209) and names (Q210) of all non-household members (all persons with numbers greater than total number of HH members) that have been mentioned in questions 201-208. Then for each person ask questions 211-221.
<table>
<thead>
<tr>
<th>No</th>
<th>Name</th>
<th>Sex</th>
<th>How did you know (Name)?</th>
<th>IF NOT RELATIVE</th>
<th>What is the religion of (NAME)?</th>
<th>For how many years have you known (NAME)?</th>
<th>Is (NAME) currently working or not?</th>
<th>Is (NAME) in the same line of work of yours?</th>
<th>What is the highest level of education of (NAME)?</th>
<th>What is the strength of relation between you and (NAME)?</th>
<th>How often do you meet with (NAME)?</th>
<th>What is the strength of relation between (NAME) and (PREVIOUSLY LISTED NAME)?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M F</td>
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<td></td>
<td></td>
<td>1</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**SECTION 3: WORK HISTORY**

WE WOULD LIKE SOME INFORMATION ABOUT YOUR WORK HISTORY.

<table>
<thead>
<tr>
<th>301</th>
<th>Job title</th>
<th>Current Job</th>
<th>Previous Job</th>
<th>2nd Previous Job</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>302</th>
<th>Job category?</th>
<th>SKILLED LABOUR</th>
<th>SKILLED LABOUR</th>
<th>SKILLED LABOUR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>UNSKILLED LABOUR</td>
<td>UNSKILLED LABOUR</td>
<td>UNSKILLED LABOUR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OTHER</td>
<td>OTHER</td>
<td>OTHER</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(SPECIFY)</td>
<td>(SPECIFY)</td>
<td>(SPECIFY)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>303</th>
<th>When did you start working in this job?</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>304</th>
<th>When did you leave this job?</th>
<th>IN KM:</th>
<th>IN KM:</th>
<th>IN KM:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>305</th>
<th>How far is (was) this job from your home?</th>
<th>IN KM:</th>
<th>IN KM:</th>
<th>IN KM:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>306</th>
<th>Who told you about, or helped you to get this job?</th>
<th>NAME:</th>
<th>NAME:</th>
<th>NAME:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IF THE PERSON WAS LISTED BEFORE (IN SECTION 1 OR SECTION 2) WRITE DOWN HIS/HER LINE NUMBR AND SKIP TO 309.</td>
<td>LISTED</td>
<td>LISTED</td>
<td>LISTED</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NOT LISTED</td>
<td>NOT LISTED</td>
<td>NOT LISTED</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SEARCH</td>
<td>SEARCH</td>
<td>SEARCH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>88</td>
<td>311</td>
<td>311</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>307</th>
<th>What is your relationship to this person at this time?</th>
<th>RELATIVE</th>
<th>RELATIVE</th>
<th>RELATIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>FRIEND</td>
<td>FRIEND</td>
<td>FRIEND</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEIGHBOUR</td>
<td>NEIGHBOUR</td>
<td>NEIGHBOUR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EMPLOYER</td>
<td>EMPLOYER</td>
<td>EMPLOYER</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EX-WORKMAT</td>
<td>EX-WORKMAT</td>
<td>EX-WORKMAT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OTHER</td>
<td>OTHER</td>
<td>OTHER</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(SPECIFY)</td>
<td>(SPECIFY)</td>
<td>(SPECIFY)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>308</th>
<th>Is this job contact person Muslim or Copt?</th>
<th>MUSLIM</th>
<th>MUSLIM</th>
<th>MUSLIM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>COPT</td>
<td>COPT</td>
<td>COPT</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>309</th>
<th>IF THE CONTACT PERSON IS NOT THE EMPLOYER:</th>
<th>WORKS IN SAME FIRM</th>
<th>WORKS IN SAME FIRM</th>
<th>WORKS IN SAME FIRM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>How did this person know about this job?</td>
<td>FROM OTHER FRIENDS</td>
<td>FROM OTHER FRIENDS</td>
<td>FROM OTHER FRIENDS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FROM THE EMPLOYER</td>
<td>FROM THE EMPLOYER</td>
<td>FROM THE EMPLOYER</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DK</td>
<td>DK</td>
<td>DK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OTHER</td>
<td>OTHER</td>
<td>OTHER</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(SPECIFY)</td>
<td>(SPECIFY)</td>
<td>(SPECIFY)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>310</th>
<th>Had you ever worked with this person in the same workplace before he told you about this job?</th>
<th>YES</th>
<th>YES</th>
<th>YES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>311</th>
<th>Generally, how satisfied or unsatisfied are (were) you with this job?</th>
<th>VERY SATISFIED</th>
<th>VERY SATISFIED</th>
<th>VERY SATISFIED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SATISFIED</td>
<td>SATISFIED</td>
<td>SATISFIED</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NEUTRAL</td>
<td>NEUTRAL</td>
<td>NEUTRAL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UNSATISFIED</td>
<td>UNSATISFIED</td>
<td>UNSATISFIED</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VERY UNSATISFIED</td>
<td>VERY UNSATISFIED</td>
<td>VERY UNSATISFIED</td>
</tr>
</tbody>
</table>

277
### Current Job

<table>
<thead>
<tr>
<th>What do (did) you like in this job?</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOOD SALARY....................A</td>
</tr>
<tr>
<td>NOT HARD.......................B</td>
</tr>
<tr>
<td>SUITABLE SCHEDULE..............C</td>
</tr>
<tr>
<td>NEAR HOME.......................D</td>
</tr>
<tr>
<td>NICE EMPLOYER..................E</td>
</tr>
<tr>
<td>NICE WORKMATES...............F</td>
</tr>
<tr>
<td>OTHER.........................X</td>
</tr>
<tr>
<td>(SPECIFY) .......................</td>
</tr>
</tbody>
</table>

### Previous Job

<table>
<thead>
<tr>
<th>What do (did) you dislike in this job?</th>
</tr>
</thead>
<tbody>
<tr>
<td>POOR SALARY.........................A</td>
</tr>
<tr>
<td>HARD.................................B</td>
</tr>
<tr>
<td>UNSUITABLE SCHEDULE..............C</td>
</tr>
<tr>
<td>FAR FROM HOME......................D</td>
</tr>
<tr>
<td>EMPLOYER NOT NICE.................E</td>
</tr>
<tr>
<td>WORKMATES NOT NICE............F</td>
</tr>
<tr>
<td>OTHER.........................X</td>
</tr>
<tr>
<td>(SPECIFY) .......................</td>
</tr>
</tbody>
</table>

### 2nd Previous Job

<table>
<thead>
<tr>
<th>Was the employer Muslim or Copt?</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUSLIM..........................1</td>
</tr>
<tr>
<td>COPT.............................2</td>
</tr>
</tbody>
</table>

### How many employees were there? |

|YES (LIST BELOW)................2 |

### How many Coptic employees were there? |

|YES (LIST BELOW)................2 |

### Are there any workmates from this workplace that you are (still) in contact with or meet outside workplace? |

| IF YES: Who? |

### Why did you leave this job? |

| POOR SALARY.....................A |
| HARD.............................B |
| UNSUITABLE SCHEDULE........C |
| FAR FROM HOME.................D |
| EMPLOYER NOT NICE............E |
| WORKMATES NOT NICE........F |
| OTHER.........................X |
| (SPECIFY) ....................... |
### SECTION 4: ATTITUDES

Now, we would like to know your opinion about some issues.

<table>
<thead>
<tr>
<th>Question</th>
<th>Response Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>How important or not important, you think, is it for you to work with an employer of the same religion as yours?</td>
<td>VERY IMPORTANT...</td>
</tr>
<tr>
<td></td>
<td>IMPORTANT..........</td>
</tr>
<tr>
<td></td>
<td>NEUTRAL........</td>
</tr>
<tr>
<td></td>
<td>NOT IMPORTANT...</td>
</tr>
<tr>
<td></td>
<td>NOT IMPORTANT AT ALL...</td>
</tr>
<tr>
<td><strong>IF IMPORTANT/VERY IMPORTANT:</strong></td>
<td></td>
</tr>
<tr>
<td>Why?</td>
<td></td>
</tr>
<tr>
<td>How important or not important, you think, is it for you to work with other workmates of the same religion as yours?</td>
<td>VERY IMPORTANT...</td>
</tr>
<tr>
<td></td>
<td>IMPORTANT..........</td>
</tr>
<tr>
<td></td>
<td>NEUTRAL........</td>
</tr>
<tr>
<td></td>
<td>NOT IMPORTANT...</td>
</tr>
<tr>
<td></td>
<td>NOT IMPORTANT AT ALL...</td>
</tr>
<tr>
<td><strong>IF IMPORTANT/VERY IMPORTANT:</strong></td>
<td></td>
</tr>
<tr>
<td>Why?</td>
<td></td>
</tr>
<tr>
<td>Generally, which workers, Coptic or Muslim, do you think are better than the other in each of the following:</td>
<td>MUSLIMS</td>
</tr>
<tr>
<td>1- Work harder</td>
<td>1</td>
</tr>
<tr>
<td>2- More honest</td>
<td>1</td>
</tr>
<tr>
<td>3- More cooperative with managers/supervisors</td>
<td>1</td>
</tr>
<tr>
<td>4- More cooperative with other workmates</td>
<td>1</td>
</tr>
<tr>
<td>5- Respect work rules (e.g. coming and leaving in time)</td>
<td>1</td>
</tr>
<tr>
<td>6- Accept lower salary</td>
<td>1</td>
</tr>
<tr>
<td>How good or bad thing, you think, is it to have workers with different religions in the same workplace?</td>
<td>VERY GOOD........</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td><strong>IF NOT NEUTRAL:</strong></td>
<td></td>
</tr>
<tr>
<td>Why?</td>
<td></td>
</tr>
<tr>
<td>How strongly do you agree or disagree that Muslims tend to employ each others more than employing Copts?</td>
<td>STRONGLY AGREE...</td>
</tr>
<tr>
<td></td>
<td>AGREE.............</td>
</tr>
<tr>
<td></td>
<td>NEUTRAL.........</td>
</tr>
<tr>
<td></td>
<td>DISAGREE.........</td>
</tr>
<tr>
<td></td>
<td>STRONGLY DISAGREE..</td>
</tr>
<tr>
<td>Question</td>
<td>Response Options</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>409 How strongly do you agree or disagree that Copts tend to employ each others more than employing Muslims?</td>
<td>STRONGLY AGREE 1, AGREE 2, NEUTRAL 3, DISAGREE 4, STRONGLY DISAGREE 5</td>
</tr>
<tr>
<td>410 How strongly do you agree or disagree that there is discrimination against Copts in Egypt?</td>
<td>STRONGLY AGREE 1, AGREE 2, NEUTRAL 3, DISAGREE 4, STRONGLY DISAGREE 5</td>
</tr>
<tr>
<td>411 IF AGREE/STRONGLY AGREE:</td>
<td>In what way?</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>412 RECORD TIME:</td>
<td></td>
</tr>
<tr>
<td>413 THANK THE RESPONDENT FOR PARTICIPATION, REASSURE CONFIDENTIALITY, AND RECORD DEGREE OF COOPERATION:</td>
<td>VERY GOOD 1, GOOD 2, MODERATE 3, BAD 4, VERY BAD 5</td>
</tr>
</tbody>
</table>

RECORD ANY NOTES:
مسح العلاقات الاجتماعية والتوظيف

استمارة العامل

أغسطس 2007

بيانات هذا المسح سرية ولن تستخدم في غير أغراض البحث العلمي
الموافقة على الاشتراك في الدراسة

أهلاً، أنا اسمي .............................. . إحياناً بحث عن التنظيف والعلاقات الاجتماعية. وحاجي مدقرين قوي إنك تشارك عاناناً. وعازو أسالك عن علاقاتك الاجتماعية وعن خبرتك العملية وازاي لاحيت الشغل بتعاآك. والمقابلة متخذة حوالي 30 دقيقة. ونحب إذا تعرفك إن أي معلومات متقلوبة حتى بسي ومسح حيتكها ححد تاني. ومشاركتك في الدراسة تطوعية وحضورتك ممكن تختار إنك م DWCQ على أي سؤال، أو تنتهي المقابلة في أي وقت انت تحبه. ومع ذلك نحب قوي إنك تشارك عانانا لأن مشاركتك دى حاجة مهمة قوي لينا.

هل توجب تنب سأني عن أي حاجة في البحث؟

البقي من فضلكى ممكن تنتدى دلوقتي؟

إحنا الباحث

المستجيب وافق على المقابلة  

أبدا المقابلة

المستجيب لم يوافق على المقابلة

سجل سبب الرفض لم توافق

بيانات تعريفية

اسم المستجيب........................................

الديانة: مسلم ............................. 1

العنوان بالفصيل:.................................

المحافظة:.................................

الاسم:........................................

الشريحة:........................................

تاريخ المقابلة: 2007 / ...

يوم ونهاية المقابلة:...

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القسم الأول: خلفية المستجيب وتكوين الأسرة المعيشية

في البداية نحن نعرف بعض المعلومات عن أسرتك من فضلك ملئي اسماء كل الأفراد التي عاشين معك في أسرتك

| اسم | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |

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القسم الثاني: الشبكة الاجتماعية للملتجي

وقد قلنا أن تعرف بعض المعلومات عن علاقاتك الاجتماعية، أصدقاءك، جيرانك، معارفك، زملائك في العمل.

<table>
<thead>
<tr>
<th>الاستمارة 2001</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>من وقت البداية معظم الناس يتناقل الأمور المهمة بالنسبة لها مع الناس تاون</td>
</tr>
<tr>
<td></td>
<td>قريبين منهم. من الناس التي أكتشفت أننا يمكننا تنفيذ أمورك المهمة معاهم؟</td>
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<td>تقسيم: فيه ناكي؟</td>
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<td>من معارفك خارج أسرتك (إلا إذا كنت معيماً) ساعدك قريب في حاجات خاصة بالطفل، مثله تقل عش، تنظيف، دخان أو أي أعمال كبيرة أو</td>
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<td>تقسيم: فيه ناكي؟</td>
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<td>في بعض الأحيان يمكن الواحد يحتاج إلى حجة بسيطة زي حدث عدة (عماك</td>
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<td>شاش) ... شويره سكر أو ملح أو حبيت أنك تستفس حجة بسيطة زي دي</td>
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<td>تسكنها من معي؟</td>
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<td>تقسيم: فيه ناكي؟</td>
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<td>أوحيت أنك تستفس مبلغ كبير - 1000 جعله مثلا - يمكننا تنفيذهم من</td>
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<td>تقسيم: فيه ناكي؟</td>
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<td>الاسم (إذا كان)</td>
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ملاحظة: تواصل العمل على تعبئة هذه الفورملار للتأكد من الدقة والكفاءة عند الانتهاء من التعبئة.
<table>
<thead>
<tr>
<th>الوظيفة قبل الساقية</th>
<th>الوظيفة الساقية</th>
<th>الوظيفة الحالية</th>
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<tr>
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<td>يشغله أي في (اسم المصنع). والشعل الذي قبل كده</td>
</tr>
<tr>
<td>عربة ماركة:</td>
<td></td>
<td>تقسيم عن نوع الوظيفة</td>
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<tr>
<td>عربة غير ماركة:</td>
<td></td>
<td>امتي بدأ الشعل؟</td>
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<td>أخرى (أخرى)</td>
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<td>وامتي سيت الشعل ده؟</td>
</tr>
<tr>
<td>رم السطر</td>
<td></td>
<td>والشعل ده (كان) بمعد عن بيتهم تقريباً دا أي؟</td>
</tr>
</tbody>
</table>

من اللي ذلك أو ساعدوك اتلاقي الشعل؟

إذا كان الشخص قد قدر قبل ذاك (وهي القسم الأول أو الثاني) رم السطر الخاص به لم يتمكن إلى المزمن 306.

كانت أي علاقات ب (الاسم) وقت ما ساعدوك اتلاقي الشعل؟

وباري (الاسم) مسلم ولا قبطي؟

إذا كان الشخص غير صاحب العمل:

طيب (الاسم) عرف ازاى عن الشعل؟

يا تري هل سيق انك اتلاقته مع (الاسم) في نفس المكان قبل ما تقولك أو يساعدك على الشعل؟

ويمكنك مساعدك إلى أي مدى انك (كتبت) ميسموت أو مش ميسموت من الشعل دا؟

إذا كان ميسموت/ميسموت جدًا:

أي اللي (كان) عاجبك في الشعل؟

إذا كان غير ميسموت/غير ميسموت على الإطلاق:

أي اللي (كان) مش عاجبك في الشعل؟

288
<table>
<thead>
<tr>
<th>الوظيفة السابقة</th>
<th>الوظيفة الحالية</th>
<th>هل كان صاحب الشغل دم مسلم ولا قبطي؟</th>
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<tr>
<td>A</td>
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<th>A</th>
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| A               | B               | 316                                  |

| C               | D               | 317                                  |

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<td>لا أدخِل اسم (أتباع الإسماء والتلاوة)</td>
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| A               | B               | 318                                  |

| C               | D               | 289                                  |
القسم الرابع: الاتجاهات

وبدأت نحن نبغي نعرف رأيك في بعض الموضوعات.

<table>
<thead>
<tr>
<th>الاعتراف</th>
<th>المسلم</th>
<th>المسلم أقل</th>
<th>في بعض الظروف</th>
<th>في بعض الظروف</th>
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إذا كان للمسلم جدًا جدًا: 401
إذا لم يكن محايد: 407

إذا كان للمسلم جدًا جدًا: 402
إذا لم يكن محايد: 408

إذا كان للمسلم جدًا جدًا: 403
إذا لم يكن محايد: 406

إذا كان للمسلم جدًا جدًا: 404
إذا لم يكن محايد: 405

شئك علم كده في رأيك من أفضل في العمل في الحالات التي تفاوت عليه العامل المسلم ولا

- يشتبه بهدف أكثر
- أكثر أمانًا
- يتعاون أكثر مع المدير والمشاركان ويستمع كلامهم
- يتعاون أكثر مع زملائه
- يحترم قواعد العمل (مثل تحيي العمل في المجيد، وروج في المبادئ)
- يمكن تقبل أمر آخر

إذا لم يكن محايد: 407
إذا لم يكن محايد: 408
Appendix C: NetLogo Code
Screen Shot of the Model Implemented in Netlogo
List of the NetLogo Code

;; Agent-Based Simulation Model for Social and Workplace Segregation
;; For NetLogo 4.0.3
;; By Mohamed Abdou
;; Nov 2008

;; persons are the main agents representing Workers
breed [persons person]

;; agents have a colour/group affiliation (primitive; no need to declare), homophily level,
;; and maximum network size (max number of links they can create)
persons-own [ homophily-level my-prob-to-fire net-size]

;; Define Firms
breed [Firms Firm]
;; Each firm has a number of jobs
Firms-own [n-of-jobs]

;; The employment link between a worker and a firm
undirected-link-breed [Firm-Links Firm-Link]

;; each link has age (job duration) and source of information about this job (source codes: Formal OR Referral)
Firm-Links-own [age source]

;; person-to-person links representing social networks
directed-link-breed [Social-Links Social-Link]

;; each link has a source of relation (source codes: Workplace, Network, Random)
Social-Links-own [source]

;; List of global variables
globals [  
  social-seg  ;; level of segregation in social networks  
  workplace-seg-diss  ;; level of segregation in workplaces, Dissimilarity index, D  
  workplace-seg-gini  ;; level of segregation in workplaces, Gini index, G  
  workplace-seg-gini*  ;; level of segregation in workplaces, Modified Gini Index, G*  
  unemployment-red  ;; level of unemployment for the minority (Red) agents  
  unemployment-green  ;; level of unemployment for the majority (Green) agents  
  p-links-work  ;; percentage of links through workplace  
  p-links-net  ;; percentage of links through other links  
  p-links-random  ;; percentage of random links  
  DStar  ;; Dissimilarity index in case of randomness (Computed from another simulation)  
  GStar  ;; Gini index in case of randomness (Computed from another simulation)  
  Avg-Homophily-total  ;; average Homophily of agents  
  Avg-Homophily-red  ;; average Homophily for Red agents  
  Avg-Homophily-green  ;; average Homophily for Green agents  
]  

;;;;; Setup Procedure ;;;  
;;;;; ;;;;; ;;;;;  

to setup  
clear-all  
create-society  ;; create a society and social networks  
create-workplaces  ;; Create workplaces and firms  
set-DStar  ;; Set the value of D*  
compute-work-seg  ;; compute indices for workplace seg  
compute-soc-seg  ;; compute index for social seg  
compute-unemployment  ;; compute unemployment levels  
compute-links-source  ;; compute proportions of links of various sources  
do-plots  ;; update the plots  
end
to go
  while [ticks < 500]
    [to create-society
      set-default-shape persons "Person"
      create-persons n-of-persons [ set color green
        set net-size Avg-Net-Size
        set homophily-level mean-homophily
      ]
      ask n-of (minority-proportion * n-of-persons) persons [ set color red ] ;; set the color of minority group to Red
      create-net-random
    ]
    compute-Avg-Homophily ;; compute average homophily levels
    fire-workers ;; fire workers with proper probabilities
    hire-workers ;; hire new workers
    update-SocNet ;; update social networks of agents: create new links and while dissolving some links
    compute-work-seg ;; compute indices for workplace seg
    compute-soc-seg ;; compute index for social seg
    compute-unemployment ;; compute unemployment levels
    compute-links-source ;; compute proportions of links of various sources
    do-plots ;; update the plots
    tick
  ]
end
;; set the initial Homophily levels
to set-Homophily

if Homophily-Type = "Uniform" [ ;; uniform homophily
    ask persons [  
        set homophily-level random-float 1]
]

if Homophily-Type = "Constant" [ ;; constant homophily
    ask persons [  
        set homophily-level mean-homophily]
]

if Homophily-Type = "Normal" [
    ask persons [  
        set homophily-level random-normal mean-homophily Homophily-StD ;; normal distribution for the homophily
        if homophily-level > 1 [set homophily-level 1]
        if homophily-level < 0 [set homophily-level 0]
    ]
]

end

;; create random social networks
to create-net-random
ask persons [create-Social-Links-to n-of net-size other persons [set source "random"]]
end

;; create links from different sources and dissolve the extra links
to update-SocNet
    create-links-net ;; create new links through other links
create-links-random ;; create new random links
create-links-work ;; create new links through workplaces
remove-extra-links ;; remove some links to keep the number of links below the maximum for each agent
update-Homophily ;; update agents' homophily levels
end

;; update Homophily levels of agents
to update-Homophily
;; declare some working variables

let Ingroup-Prop-In-SocNet 0 ;; proportion of links to agents of the same color
let Ingroup-Prop-In-Workplace 0 ;; proportion of agents of the same color in the workplace
let Mean-Homophily-Of-Alters 0 ;; mean homophily level of alters
let Mean-Homophily-Of-Workmates 0
let temp 0
let Avg-Homophily 0
let Ingroup-Proportion 0
let temp-Firm nobody
let tempset nobody
let tempagent nobody
let para-sum1 1 + Network-Composition-Const + Mean-Homophily-Of-Alters-Const + Workplace-Composition-Const + Mean-Homophily-Of-Workmates-Const + Overall-Mean-Homophily-Const
let para-sum2 1 + Network-Composition-Const + Mean-Homophily-Of-Alters-Const + Overall-Mean-Homophily-Const
let Overall-Mean-Homophily mean [homophily-level] of persons

ask persons [
let Network-Composition-Effect 0
let Workplace-Composition 0 ;; the effect of workplace composition on the homophily level
let mycolor color
let my-who who
298
ifelse color = red
[set Ingroup-Proportion minority-proportion]
(set Ingroup-Proportion (1 - minority-proportion)) ;; Green agent's group proportion is 1-minority-proportion

set Ingroup-Prop-In-SocNet (count Out-Social-Link-neighbors with [color = mycolor]) / (count Out-Social-Link-neighbors)

set Network-Composition-Effect (Ingroup-Prop-In-SocNet - Ingroup-Proportion) / (1 - Ingroup-Proportion)

if Network-Composition-Effect < 0 [set Network-Composition-Effect 0]
if Network-Composition-Effect > 1 [set Network-Composition-Effect 1]

set Mean-Homophily-Of-Alters mean [homophily-level] of Out-Social-Link-neighbors

;; workplace effect
ifelse count Firm-Link-neighbors > 0 ;; if the agent is currently working ...

[ ask Firm-Link-neighbors [ ;; this is the firm where the agent works
  set Ingroup-Prop-In-Workplace count Firm-Link-neighbors with [color = Mycolor] / count Firm-Link-neighbors
  set Mean-Homophily-Of-Workmates mean [homophily-level] of Firm-Link-neighbors with [who != my-who]
]

set Workplace-Composition (Ingroup-Prop-In-Workplace - Ingroup-Proportion) / (1 - Ingroup-Proportion)

if Workplace-Composition < 0 [set Workplace-Composition 0]
if Workplace-Composition > 1 [set Workplace-Composition 1]


] ;; for unemployed agents ...

set homophily-level (homophily-level + (Network-Composition-Const * Network-Composition-Effect) + (Mean-Homophily-Of-Alters-Const * Mean-Homophily-Of-Alters) + (Overall-Mean-Homophily-Const * Overall-Mean-Homophily))/ para-sum2
]
if homophily-level > 1 [set homophily-level 1]
if homophily-level < 0 [set homophily-level 0]
end

;; create new random links
to create-links-random
ask persons [if (random-float 1) < new-link-random [create-Social-Link-to one-of other persons with [not in-Social-Link-neighbor? myself] [set source "random"]]
]
end

;; create new links through other links
to create-links-net
ask persons [let mycolor color
let ingroup-proportion 0 ;; agent's group proportion
if (random-float 1) < new-link-net [let my-who who
let tempagent self
let tempset nobody
ask Out-Social-Link-neighbors [set tempset (turtle-set tempset Out-Social-Link-neighbors with [who != my-who and not in-Social-Link-neighbor? tempagent])]
if tempset != nobody and any? tempset [set ingroup-proportion count tempset with [color = mycolor] / count tempset
ifelse (ingroup-proportion > 0 and ingroup-proportion < 1) [1]
if else (random-float 1) < (ingroup-proportion + homophily-level * (1 - ingroup-proportion))
    [create-Social-Link-to one-of tempset with [color = mycolor] [set source "network"]]
    [create-Social-Link-to one-of tempset with [color != mycolor] [set source "network"]]
  ]
  create-Social-Link-to one-of tempset [set source "network"]
end

;; create new links from workplace
to create-links-work
let temp-Firm nobody
let tempset nobody
let ingroup-proportion 0
ask persons with [count Firm-Link-neighbors > 0] [ ;; only working agents
  let mycolor color
  if (random-float 1) < new-link-work [;
    let my-who who
    let tempagent self
;
    tempset is the set of workmates with no social link to the agent
    ask Firm-Link-neighbors [set tempset Firm-Link-neighbors with [who != my-who and not in-Social-Link-neighbor? tempagent]]
    if tempset != nobody and any? tempset [
      set ingroup-proportion count tempset with [color = mycolor] / count tempset
      if else (ingroup-proportion > 0 and ingroup-proportion < 1)
    []
ifelse (random-float 1) < (ingroup-proportion + homophily-level * (1 - ingroup-proportion))
[create-Social-Link-to one-of tempset with [color = mycolor] [set source "workplace"]]
[create-Social-Link-to one-of tempset with [color != mycolor][set source "workplace"]]
[create-Social-Link-to one-of tempset [set source "workplace"]]
end
end

;; remove extra links randomly
to remove-extra-links
ask persons with [count my-Out-Social-Links > net-size] [ask n-of (count my-Out-Social-Links - net-size) my-Out-Social-Links [die]]
end

;; create firms and jobs
to create-workplaces
create-Firms n-of-Firms [set n-of-jobs num-of-jobs set color green]
ask n-of (minority-proportion * n-of-Firms) Firms [set color red]
Hire-Workers-Random
end

to Hire-Workers-Random
ask Firms [let n-jobs (n-of-jobs - count my-Firm-Links) ;; number of available jobs = total number of jobs - number of current workers
           if n-jobs > 0 [ create-Firm-Links-with n-of n-jobs persons with [count Firm-Link-neighbors = 0][set source "formal"]]
           set-Probability-To-Fire]
end

;; hire new worker
to hire-workers
  let n-tot 0 ; total workers in the Firm
  let temp 0 ; random number
  let Firm-color red

  ask Firms with [count my-Firm-Links < n-of-jobs] ; only Firms with number of workers less than number of jobs
    while [count my-Firm-Links < n-of-jobs] ;
      set n-tot count my-Firm-Links
      set temp random-float 1
      if n-tot = 0 [set temp 1] ;; when there are no workers use formal search
      elseif temp < level-of-referral-hiring
        [ Hire-Referral] ;; Referral Hiring
        [ Hire-Formal] ;; Formal Hiring
    ]
  set Probability-To-Fire
end

;; hire new worker through referrals
to Hire-Referral
  let candidates-set nobody
  let Firm-color color
  let P 0
  let h hiring-discrimination * mean [homophily-level] of Firm-Link-neighbors

    set P count candidates-set with [color = Firm-color] / count candidates-set
    ifelse (P > 0 and P < 1)
      [ ifelse (random-float 1) < (P + h * (1 - P)) ]
[create-Firm-Link-with one-of candidates-set with [color = Firm-color] [set source "referral"]]
[create-Firm-Link-with one-of candidates-set with [color ! = Firm-color] [set source "referral"]]

create-Firm-Link-with one-of candidates-set [set source "referral"]

Hire-formal ;; if there are no workers available through referral, formal hiring is used

end

;; hire new worker through formal methods (random)
to Hire-formal
create-Firm-Link-with one-of persons with [count Finn-Link-neighbors = 0] [set source "formal"]
end

to set-Probability-To-Fire
let P 0
ask Firms with [count Firm-Link-neighbors > 0]
[
set P count Firm-Link-neighbors with [color = red] / count Firm-Link-neighbors
ask Firm-Link-neighbors
[
ifelse color = red
[set my-prob-to-fire prob-to-fire * (1 + homophily-level * (minority-proportion - P))]
[set my-prob-to-fire prob-to-fire * (1 + homophily-level * (P - minority-proportion))]
]
end]
;; compute indexes of work seg

; to compute-work-seg

let T count Firm-Links ; count of all working persons

let C count persons with [color = red and count Firm-Link-neighbors > 0] ; count of all minority working persons

if C = 0 [ SET workplace-seg-diss 1
              SET workplace-seg-gini 1
              stop]

let P c / t

let tk 0

let ck 0

let pk 0

let tj 0

let cj 0

let pj 0

let gini 0 ;;; Gini segregation index

let diss 0 ;;; Index of dissimilarity

ask Firms[
    set tk count Firm-Link-neighbors
    set ck count Firm-Link-neighbors with [color = red ]
    set pk ck / tk
    set diss diss + (tk * abs (pk - P) )

ask Firms[
    set tj count Firm-Link-neighbors
    set cj count Firm-Link-neighbors with [color = red ]
    set pj cj / tj
    set gini gini + (tk * tj * abs (pk - pj) )
]

]
set gini $gini = \frac{2 \cdot T \cdot T \cdot P \cdot (1 - P)}{T \cdot T \cdot P \cdot (1 - P)}$
set diss $diss = \frac{2 \cdot G \cdot T \cdot P \cdot (1 - T)}{G \cdot T \cdot P \cdot (1 - P)}$

SET workplace-seg-gini $gini$

ifelse $diss \geq D_{Star}$ [set diss $diss - D_{Star}$] [set diss 0]
ifelse $gini \geq G_{Star}$ [set gini $gini - G_{Star}$] [set gini 0]

SET workplace-seg-diss $diss$
SET workplace-seg-gini* $gini$

end

---------------------------------------------------------------------------------------------

to compute-soc-seg
;;;; to Compute segregation of the social network of agents based on Freeman (1978) Index
let m n-of-persons ; count of all persons
let mg n-of-persons * minority-proportion ; count of all minority persons
let n count Social-Links

let Estar count Social-Links with [color] of end1 != [color] of end2

let Exp-Estar $(n \cdot 2 \cdot mg \cdot (m - mg)) / (m \cdot (m - 1))$

let S $S = \text{Exp-Estar} - \text{Estar}$ ;; segregation index

ifelse $S < 0$ [set S 0] [set S $S / \text{Exp-Estar}$]

SET social-seg S
end
to do-plots
  set-current-plot "Segregation"
  set-current-plot-pen "social-seg"
  plot social-seg
  set-current-plot-pen "workplace-seg-gini"
  plot workplace-seg-gini
  plot workplace-seg-gini*

set-current-plot "unemployment"
set-current-plot-pen "unemployment-red"
plot unemployment-red
set-current-plot-pen "unemployment-green"
plot unemployment-green
set-current-plot "link-origin"
set-current-plot-pen "work"
plot p-links-work
set-current-plot-pen "other-links"
plot p-links-net
set-current-plot-pen "random"
plot p-links-random

;;
set-current-plot "homophily"

set-current-plot-pen "H-red"
plot Avg-Homophily-red

set-current-plot-pen "H-green"
plot Avg-Homophily-green

set-current-plot-pen "H-total"
plot Avg-Homophily-total
end

to compute-unemployment
set unemployment-red (count persons with [count Firm-Link-neighbors = 0 and color = red]) / count persons with [color = red]
set unemployment-green (count persons with [count Firm-Link-neighbors = 0 and color = green]) / count persons with [color = green]
end

to compute-links-source
let tot-links count Social-Links
set p-links-work count Social-Links with [source = "workplace"] / tot-links
set p-links-net count Social-Links with [source = "network"] / tot-links
set p-links-random count Social-Links with [source = "random"] / tot-links
end

to fire-workers
let temp 0 ;; random number
let Firm-Linkage 0
ask persons with [count my-Firm-Links > 0] ; only fire working agents
  [ set temp random-float 1
    set Firm-Linkage [age] of one-of my-Firm-Links
    if temp < my-prob-to-fire or Firm-Linkage > 50 [ask my-Firm-Links [ die ] ]
  ]
end

to compute-Avg-Homophily
  set Avg-Homophily-red mean [homophily-level] of persons with [color = red]
  set Avg-Homophily-green mean [homophily-level] of persons with [color = green]
  set Avg-Homophily-total mean [homophily-level] of persons
end

;; The values of Dsta and GStar are read from external text file, and have been calculated using another simulation model

to set-DStar
  set Dstar 0
  set GStar 0
  file-open "data.txt"
  while [not file-at-end?]
    [ if n-of-persons = file-read and minority-proportion = file-read and n-of-Firms = file-read and num-of-jobs = file-read [ set Dstar file-read
      set GStar file-read
      file-close
      Stop]
  ]

  file-close
  show "No Gstar or Dstar found for the specified parameters, both are assumed to be zero"
end
NetLogo Code to Compute $G^*$ and $D^*$

;; This model is used to generate $G^*$ and $D^*$ for some combinations of firm size, number of jobs, number of persons, and minority proportion.
;; For NetLogo 4.0.3
;; By Mohamed Abdou
;; Nov 2008

;; agents have a colour/group affiliation (primitive; no need to declare)
breed [persons person]
breed [firms firm]

undirected-link-breed [flinks flink] ;; person-to-firm link

Firms-own [n-of-jobs]

globals [ workplace-seg ;; level of segregation in workplaces
          minority-proportion
          n-of-persons
          n-of-firms
          num-of-jobs
          diss ;; Dissimilarity Index
          gini ;; Gini Index
          Dstar ;; Dissimilarity index in case of randomness
          Gstar ;; Gini index in case of randomness
          ]

;; Main Procedures;;;

;; to go
let Sim-count 1
let fname "" ;; file name to be exported
let tick-count 0

while [Sim-count <= 68]
[
  clear-all
  set-parameters (sim-count)
  set tick-count 1
  while [ticks < 200]
  [ create-society
    create-workplaces
    compute-work-seg
    do-plots
    set Dstar Dstar + diss
    set Gstar Gstar + gini
    tick
  ]
  set Dstar Dstar / ticks ;; DStar is set to the average value for the 200 runs
  set Gstar Gstar / ticks ;; GStar is set to the average value for the 200 runs
  set fname (word "c:/Mohamed/model/Dstar/plot" sim-count ".csv") ;; export the results to .csv file
  export-plot "Segregation" fname
  set Sim-count Sim-count + 1
]
stop
end

to create-society
clear-turtles
  create-persons minority-proportion * n-of-persons [ set color red ] ;; minority group
  create-persons (1 - minority-proportion) * n-of-persons [ set color green ] ;; majority group
end

to create-workplaces
  clear-links
  create-firms n-of-firms [ set n-of-jobs num-of-jobs ]
  ask n-of (num-of-jobs * n-of-firms) persons [ create-flink-with one-of firms with ]
end

to compute-work-seg
  let T count flinks ; count of all working persons
  let C count persons with [color = red and count flink-neighbors != 0] ; count of all minority working persons
  if C = 0 [ SET workplace-seg 1 stop]
  let P c / t
  let k 0
  let j 0
  let tk 0
  let ck 0
  let pk 0
  let tj 0
  let cj 0
  let pj 0
  let who_min 0
  let who_max 0
  set gini 0 ;; Gini segregation index
  set diss 0 ;; Index of dissimilarity
ask min-one-of firms [who] [set who_min who]
set who_max who_min + n-of-firms - 1

set k who_min
while [k <= who_max]
  [ask firm k[
    set tk count persons with [flink-neighbor? myself
    set ck count persons with [flink-neighbor? myself and color = red ]
    set pk ck / tk
    set diss diss + (tk * abs (pk - P) )
    set j who_min
    while [j <= who_max]
      [ask firm j[
        set tj count persons with [flink-neighbor? myself
        set cj count persons with [flink-neighbor? myself and color = red ]
        set pj cj / tj
        set gini gini + (tk * tj * abs (pk - pj))
      ]
      set j j + 1
    ]
  ]
  set k k + 1
]

set gini gini / (2 * T * T * P * (1 - P))
set diss diss / (2 * T * P * (1 - p))
end
to do-plots

set-current-plot "Segregation"
set-current-plot-pen "gini"
plot gini
set-current-plot-pen "diss"
plot diss
end

to set-parameters [sim-count]
  if sim-count = 1 [ set n-of-persons 100 set minority-proportion 0.1 set n-of-firms 5 set num-of-jobs 16 ]
  if sim-count = 2 [ set n-of-persons 100 set minority-proportion 0.1 set n-of-firms 8 set num-of-jobs 10 ]
  if sim-count = 3 [ set n-of-persons 100 set minority-proportion 0.1 set n-of-firms 10 set num-of-jobs 8 ]
  if sim-count = 4 [ set n-of-persons 100 set minority-proportion 0.1 set n-of-firms 16 set num-of-jobs 5 ]
  if sim-count = 5 [ set n-of-persons 100 set minority-proportion 0.2 set n-of-firms 5 set num-of-jobs 16 ]
  if sim-count = 6 [ set n-of-persons 100 set minority-proportion 0.2 set n-of-firms 8 set num-of-jobs 10 ]
  if sim-count = 7 [ set n-of-persons 100 set minority-proportion 0.2 set n-of-firms 10 set num-of-jobs 8 ]
  if sim-count = 8 [ set n-of-persons 100 set minority-proportion 0.2 set n-of-firms 16 set num-of-jobs 5 ]
  if sim-count = 9 [ set n-of-persons 100 set minority-proportion 0.3 set n-of-firms 5 set num-of-jobs 16 ]
  if sim-count = 10 [ set n-of-persons 100 set minority-proportion 0.3 set n-of-firms 8 set num-of-jobs 10 ]
  if sim-count = 11 [ set n-of-persons 100 set minority-proportion 0.3 set n-of-firms 10 set num-of-jobs 8 ]
  if sim-count = 12 [ set n-of-persons 100 set minority-proportion 0.3 set n-of-firms 16 set num-of-jobs 5 ]
  if sim-count = 13 [ set n-of-persons 100 set minority-proportion 0.4 set n-of-firms 5 set num-of-jobs 16 ]
  if sim-count = 14 [ set n-of-persons 100 set minority-proportion 0.4 set n-of-firms 8 set num-of-jobs 10 ]
  if sim-count = 15 [ set n-of-persons 100 set minority-proportion 0.4 set n-of-firms 10 set num-of-jobs 8 ]
  if sim-count = 16 [ set n-of-persons 100 set minority-proportion 0.4 set n-of-firms 16 set num-of-jobs 5 ]
  if sim-count = 17 [ set n-of-persons 200 set minority-proportion 0.1 set n-of-firms 5 set num-of-jobs 32 ]
  if sim-count = 18 [ set n-of-persons 200 set minority-proportion 0.1 set n-of-firms 10 set num-of-jobs 16 ]
if sim-count = 19 [ set n-of-persons 200 set minority-proportion 0.1 set n-of-firms 16 set num-of-jobs 10 ]
if sim-count = 20 [ set n-of-persons 200 set minority-proportion 0.1 set n-of-firms 20 set num-of-jobs 8 ]
if sim-count = 21 [ set n-of-persons 200 set minority-proportion 0.2 set n-of-firms 20 set num-of-jobs 16 ]
if sim-count = 22 [ set n-of-persons 200 set minority-proportion 0.2 set n-of-firms 10 set num-of-jobs 16 ]
if sim-count = 23 [ set n-of-persons 200 set minority-proportion 0.2 set n-of-firms 16 set num-of-jobs 10 ]
if sim-count = 24 [ set n-of-persons 200 set minority-proportion 0.2 set n-of-firms 20 set num-of-jobs 8 ]
if sim-count = 25 [ set n-of-persons 200 set minority-proportion 0.3 set n-of-firms 16 set num-of-jobs 10 ]
if sim-count = 26 [ set n-of-persons 200 set minority-proportion 0.3 set n-of-firms 10 set num-of-jobs 16 ]
if sim-count = 27 [ set n-of-persons 200 set minority-proportion 0.3 set n-of-firms 10 set num-of-jobs 16 ]
if sim-count = 28 [ set n-of-persons 200 set minority-proportion 0.3 set n-of-firms 20 set num-of-jobs 8 ]
if sim-count = 29 [ set n-of-persons 200 set minority-proportion 0.4 set n-of-firms 16 set num-of-jobs 10 ]
if sim-count = 30 [ set n-of-persons 200 set minority-proportion 0.4 set n-of-firms 10 set num-of-jobs 16 ]
if sim-count = 31 [ set n-of-persons 200 set minority-proportion 0.4 set n-of-firms 16 set num-of-jobs 10 ]
if sim-count = 32 [ set n-of-persons 200 set minority-proportion 0.4 set n-of-firms 20 set num-of-jobs 8 ]
if sim-count = 33 [ set n-of-persons 200 set minority-proportion 0.4 set n-of-firms 5 set num-of-jobs 80 ]
if sim-count = 34 [ set n-of-persons 500 set minority-proportion 0.1 set n-of-firms 5 set num-of-jobs 80 ]
if sim-count = 35 [ set n-of-persons 500 set minority-proportion 0.1 set n-of-firms 10 set num-of-jobs 40 ]
if sim-count = 36 [ set n-of-persons 500 set minority-proportion 0.1 set n-of-firms 40 set num-of-jobs 10 ]
if sim-count = 37 [ set n-of-persons 500 set minority-proportion 0.2 set n-of-firms 20 set num-of-jobs 40 ]
if sim-count = 38 [ set n-of-persons 500 set minority-proportion 0.2 set n-of-firms 20 set num-of-jobs 40 ]
if sim-count = 39 [ set n-of-persons 500 set minority-proportion 0.2 set n-of-firms 40 set num-of-jobs 20 ]
if sim-count = 40 [ set n-of-persons 500 set minority-proportion 0.2 set n-of-firms 40 set num-of-jobs 10 ]
if sim-count = 41 [ set n-of-persons 500 set minority-proportion 0.3 set n-of-firms 5 set num-of-jobs 80 ]
if sim-count = 42 [ set n-of-persons 500 set minority-proportion 0.3 set n-of-firms 10 set num-of-jobs 10 ]
if sim-count = 43 [ set n-of-persons 500 set minority-proportion 0.3 set n-of-firms 20 set num-of-jobs 20 ]
if sim-count = 44 [ set n-of-persons 500 set minority-proportion 0.3 set n-of-firms 40 set num-of-jobs 10 ]
if sim-count = 45 [ set n-of-persons 500 set minority-proportion 0.4 set n-of-firms 5 set num-of-jobs 80 ]
if sim-count = 46 [ set n-of-persons 500 set minority-proportion 0.4 set n-of-firms 10 set num-of-jobs 10 ]
if sim-count = 47 [ set n-of-persons 500 set minority-proportion 0.4 set n-of-firms 20 set num-of-jobs 20 ]
if sim-count = 48 [ set n-of-persons 500 set minority-proportion 0.4 set n-of-firms 40 set num-of-jobs 10 ]
if sim-count = 49 [ set n-of-persons 1000 set minority-proportion 0.1 set n-of-firms 10 set num-of-jobs 80 ]
if sim-count = 50 [ set n-of-persons 1000 set minority-proportion 0.1 set n-of-firms 20 set num-of-jobs 40 ]
if sim-count = 51 [ set n-of-persons 1000 set minority-proportion 0.1 set n-of-firms 40 set num-of-jobs 20 ]
if sim-count = 52 [ set n-of-persons 1000 set minority-proportion 0.1 set n-of-firms 50 set num-of-jobs 16 ]
if sim-count = 53 [ set n-of-persons 1000 set minority-proportion 0.1 set n-of-firms 80 set num-of-jobs 10 ]
if sim-count = 54 [ set n-of-persons 1000 set minority-proportion 0.2 set n-of-firms 10 set num-of-jobs 80 ]
if sim-count = 55 [ set n-of-persons 1000 set minority-proportion 0.2 set n-of-firms 20 set num-of-jobs 40 ]
if sim-count = 56 [ set n-of-persons 1000 set minority-proportion 0.2 set n-of-firms 40 set num-of-jobs 20 ]
if sim-count = 57 [ set n-of-persons 1000 set minority-proportion 0.2 set n-of-firms 50 set num-of-jobs 16 ]
if sim-count = 58 [ set n-of-persons 1000 set minority-proportion 0.2 set n-of-firms 80 set num-of-jobs 10 ]
if sim-count = 59 [ set n-of-persons 1000 set minority-proportion 0.3 set n-of-firms 10 set num-of-jobs 80 ]
if sim-count = 60 [ set n-of-persons 1000 set minority-proportion 0.3 set n-of-firms 20 set num-of-jobs 40 ]
if sim-count = 61 [ set n-of-persons 1000 set minority-proportion 0.3 set n-of-firms 40 set num-of-jobs 20 ]
if sim-count = 62 [ set n-of-persons 1000 set minority-proportion 0.3 set n-of-firms 50 set num-of-jobs 16 ]
if sim-count = 63 [ set n-of-persons 1000 set minority-proportion 0.3 set n-of-firms 80 set num-of-jobs 10 ]
if sim-count = 64 [ set n-of-persons 1000 set minority-proportion 0.4 set n-of-firms 10 set num-of-jobs 80 ]
if sim-count = 65 [ set n-of-persons 1000 set minority-proportion 0.4 set n-of-firms 20 set num-of-jobs 40 ]
if sim-count = 66 [ set n-of-persons 1000 set minority-proportion 0.4 set n-of-firms 40 set num-of-jobs 20 ]
if sim-count = 67 [ set n-of-persons 1000 set minority-proportion 0.4 set n-of-firms 50 set num-of-jobs 16 ]
if sim-count = 68 [ set n-of-persons 1000 set minority-proportion 0.4 set n-of-firms 80 set num-of-jobs 10 ]

end