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Three Essays on Labour Market and Efficiency of Development Interventions

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Introduction

This dissertation examines the effects of structural deficiencies in the Palestinian labour market on three critical dimensions that have different long-lasting effects on sustainable development in Palestine. The Palestinian labour market is characterized by low efficiency, poor regulation and high segmentation. This is reflected by poor work conditions, work-related gender bias against women, low rates of labour force participation of women, low wages compared with high living expenses, weak labour unions and high unemployment rates. These structural problems and the associated high unemployment rate have obliged a large part of the Palestinian labour force to seek employment outside Palestine, enhancing the *brain drain*. They also prompted the present study on the effects on three different dimensions: 1) the effect of adopting anti-discrimination policies of recruitment with equal opportunities for men and women and the extent to which this inequality of recruitment creates a gender pay gap; 2) the effect of brain drain on the ability of current human capital stock in leveraging capital-intensive production by facilitating diffusion of technology across Palestinian firms; 3) the social aspects of high unemployment, specifically the effect of unemployment and associated poverty on the effectiveness of international and local aid programs.

The importance of this dissertation stems from the need to understand the socio-economic results of more than 20 years of investment in the Palestinian economy since the Oslo agreement of 1993. The Oslo agreement maintained borders under the full control of Israel and did not give the Palestinians full access to their natural resources. Constrained access to international markets and inability to achieve full utilization of natural resources undermine sustainable development.

The first chapter examines gender-based occupational segregation and its association with gender pay discrimination in the private and public sectors of the Palestinian labour market, and measures the effect of this discrimination on female employment. This study is timely since the Palestinian Authority has implemented antidiscrimination polices to ensure equal opportunity for men and women. This chapter also examines the critical role of investment in education in segregating or desegregating the labour market.

The main results indicate that the recruitment mechanism used by the public and private sectors leads to occupational segregation by gender in both sectors. Although there is gender-based segregation in the public sector, it did not cause a pay gap to the detriment of women, which demonstrates that the public sector effectively implemented antidiscrimination policies. The most harmful discrimination exists in the private sector where there is a large pay gap against women. This discrimination against women has resulted in loss of women's jobs in favour of men. The present chapter provides strong evidence that the Palestinian labour market is still inefficient. Policy makers are urged to take further steps to mitigate discrimination against women in employment and promotion policies.

The second chapter examines the issue of human capital accumulation as a result of investment in education and vocational training and the extent to which it facilitates the diffusion of technology across Palestinian firms. We focus on the quality of the people employed by Palestinian

firms, and estimate the extent to which the decision to adopt new technology is affected by the existence of skilled and educated labour.

The results confirm that despite the brain drain of Palestinian human capital from the local market, the current human capital still plays a critical role in decisions to adopt new technologies. Once a firm recognizes that the type of product it produces requires a specific type of technology, it hires staff qualified to handle this technology.

The third chapter focuses on social aspects of structural deficiencies in the labour market and examines how high unemployment and poverty rates undermine international and local aid programs aimed at securing food and reducing hunger in vulnerable households across the West Bank and Gaza Strip. We compare international and local aid programs and cash versus in-kind interventions. The results show that although international aid programs have failed to pull households out of poverty due to the high unemployment rate, there is still evidence that these programs play a critical role in mitigating food insecurity and reducing hunger.

Different econometric techniques were used to meet the goals of the studies. The first chapter used the Multinomial Logit Model to estimate the probability of being in male- versus female-dominated occupations, and the OXACA decomposition to measure the effect of discrimination in widening the pay gap between men and women. Baldwin and Johnson techniques were used to estimate the effect of discrimination on women's employment by comparing the effect of non-discriminatory and discriminatory wages on the probability of employment. The second chapter used the double-hurdle model to tackle the many zero values of expenditure on technology and solved the problem of endogeneity by including three instrumental variables in the model. The third chapter used propensity score matching techniques between treatment and control groups and handled the problem of sample selection bias, that may arise from focusing on specific aid programs and ignoring others, by creating three heterogeneous groups (households benefiting from international aid, households benefiting from the Palestinian Authority, and households without any kind of aid program).

Chapter 1

Gender-based Occupational Segregation and the Gender Pay Gap in Palestine

Abstract

The issue of occupational segregation and wage discrimination in the Palestinian labour market is analysed in this paper, with a focus on the role of the public sector in enforcing/implementing antidiscrimination polices, and the final effect of wage discrimination on women's employment. The study used labour survey data of 2018, and the results indicate that the recruitment mechanism adopted by the public and private sectors resulted in occupational segregation by gender in both sectors. Horizontal occupational segregation in the public sector did not lead to wage discrimination due to antidiscrimination polices implemented by the government, but it did not prevent vertical segregation. Horizontal segregation tends to benefit women by mitigating discrimination, while vertical segregation is seen as a causal factor of discrimination. Discrimination is seen to exist more in the high wage bracket where women encounter glass-ceiling discrimination. The data also shows that women's investment in education raises their numbers in the upper ranks of occupations, thus supporting desegregation polices. Wage discrimination in the private sector tends to disincentivise women from entering the labour market. This effect is seen to be larger in the Gaza Strip than in the West Bank and it is attributed to the greater potential discrimination in the former.

Keywords: occupational segregation, wage discrimination, employment effect of discrimination, gender pay gap.

1.1 Introduction

Gender-based occupational segregation exists in all economies with different levels of economic development and different religions and cultures. Gender-based occupational segregation has received remarkable attention from economists, sociologists and policy makers due to its negative effects on women. It is considered a major cause of labour market inefficiencies, wage discrimination and economic rigidity (Anker, 1997).

Vertical segregation focuses on men (women) at the top of occupational ladders ranked by specific attributes such as income, prestige and job stability, whereas horizontal segregation considers men (women) in occupations or sectors without ranking and is sometimes referred to simply as *segregation* (Mayrhofer et al., 2009). Vertical segregation in favour of men prevents women from occupying high positions in the hierarchy. This enables men to benefit from the income and power associated with these positions, which in turn strengthens the gender pay gap and its associated adverse impact on women's participation in economic development (Anker, 1997).

Gender pay gap discrimination is a potential consequence of segregation. It has far-reaching effects on women, motivating them to drop out of the labour force, and when the rewards of skilled versus unskilled labour are reduced due to discrimination, women have less incentive to invest in human capital. This in turn limits future generations of women from becoming productive members of the labour force (Baldwin and Johnson, 1992). Most of the literature sheds light on the role of the public sector in alleviating labour market inefficiency by implementing and enforcing gender-equality polices. The public sector has a different wage structure from the private sector, which tends to narrow pay gaps and reduce occupational segregation.

Palestinian women have experienced a remarkable improvement in the terms of education, which has leveraged their participation in the labour market. On average, the years of education of employed women increased by around two years between 2002 and 2018 (10.1 years versus 8.1 years), and this improvement has been reflected in women's advancement into higher occupations (legislators, senior officials and managers) from 2.4% in 2002 to 4.4% in 2018 (PCBS, labour force surveys 2002 and 2018). However, women still encounter a high rate of occupational segregation by gender and wage discrimination. Here we investigate the factors determining the wages offered to women.

The added value of this paper with respect to the literature on the Palestinian labour market concerns the role of education in occupational segregation. The paper reports the changes in the efficiency of the Palestinian labour market in the sixteen-year period in terms of gender-based segregation and its associated effects on wages and employment. It also addresses the role of the public sector in boosting gender equality in recruitment (horizontal segregation) and promotion (vertical segregation). It examines the relationship between occupational segregation and wage discrimination.

Section 2 considers the most prominent theories on occupational segregation and its association with pay-gap discrimination. Section 3 discusses the sources of data. Section 4 concerns the dynamics of the Palestinian labour market in the 2002-2018 study period. Section 5 discusses gender-based occupational segregation in the Palestinian labour market. Section 6 looks at the role of vertical education in facilitating occupational desegregation, while section 7 studies the gender pay-gap in Palestine. Section 8 estimates potential discrimination in the gender pay gap and section 9 examines the role of occupational segregation in this potential discrimination. Finally, section 10 concludes with the cost of discrimination against women in terms of number of jobs lost.

1.2 Theoretical background

Gender-based segregation of jobs is a pervasive phenomenon across the world. Economists and psychologists have studied the roots of this segregation and the extent to which it protects or harms women in terms of inequality of pay and work conditions. Occupational segregation by sex reflects the extent to which one gender is different from the other across occupations. Jobs are not equally offered to or demanded by men and women. Bettio (2002, p.70) defined occupational segregation as a descriptive term denoting the final outcome of the slow and sticky process of allocating individuals to jobs which involves choices and investments in human capital that reflect past and present discrimination as well as genuine or social preferences. Bettio's definition considers the preference-formation process of men and women before their decision to invest in human capital and enter the labour market. The final outcome of this allocation process may lead to under (over) representation of men (women) in different employment categories. Vertical segregation focuses on the ranking of men (women) at the top of occupational ladders according to specific attributes such as income, prestige and job stability, whereas horizontal segregation looks at the collocation of men (women) in occupations or sectors without ordering and is sometimes referred to simply as *segregation*.

Occupational segregation is generally viewed by economists and feminists as a leading cause of wage discrimination, justifying the critical overtones of academics in the early 1960s regarding the radical division between men and women that it reflects. In this paper we therefore shine a light on the pay gap in Palestine, and the extent to which occupational segregation causes this disparity in wages between men and women.

Arrow (1972) viewed discrimination in the labour market as the physical or social distance between the manager and the workers. Discriminatory employers maximize a combination of money profits and their own personal utility which is inversely related to the extent to which they associate with the minority workers (Becker, 1971). Although Becker's model is more applicable to small firms where there are frequent fractures between manager and workers, it is also applicable to big firms where discrimination is part of the corporate culture. Discrimination is also viewed as persistent wage disparities between clearly identifiable labour segments with equal productivity potential (Cain, 1986). The latter definition is used in this paper to test the link between segregation and discrimination.

The debate on the root causes of segregation has held the centre stage in economics and sociology since the 1970s. A number of theoretical development and empirical studies have investigated this widespread phenomenon (Anker, 1997, Chiplin and Sloane, 1976, Cain, 1986, Blau et al., 2006, Chapters 5-7, Bettio, 2008, England, 1982). The literature on occupational segregation generally revisits key factors that explain segregation and can be singled out as: comparative advantage, under-investment, socialization and stereotypes, entry barriers, organizational practices and different income roles (Mayrhofer et al., 2009). Biological comparative advantage such as muscle power versus dexterity was the oldest explanation for occupational segregation, however with technological advances the weight of

muscle power has lessened in favour of brain skills and mind work. Investment in education and training therefore became a strong factor in the division of labour. Mincer (1974) and Heckman (1979) ascribed confinement of women to low-skill low-paid occupations to low investment in education and training due to their comparative advantage in domestic production. Under-investment in education and training was tackled by Coate and Loury (1993) who considered expected discrimination against women to be a discouraging factor against investment in education and training. However, recent statistics show a remarkable improvement in women's investment in education, which makes the human capital theory obsolete. Still the issue of vertical (by the level of education) versus horizontal education (by the field of education/specialization) matters in the division of labour. Valentova et al. (2007) concluded that horizonal segregation in education is much more related to occupational segregation than vertical segregation of education. May (2008) provides examples of past arguments to justify formal barriers against admission to higher education in the USA still being used to justify segregation in schools and universities.

The historical debate in the 1970s and 1980s on the explanations of occupational segregation did not assume perfect competitive markets and looked at segregation as a reason for discrimination. Lack of competition may take shapes ranging from restrictive access to segmentation of labour markets; these are caused by factors such as the role of institutions, patriarchy and class (Bettio, 2008). Bergmann (1974) suggested that labour-market entry barriers for women crowded women into few specific occupations, and this overcrowding depressed women's wages compared to those of men. Economists view these entry barriers as reflecting the power of unionized male workers in protecting high-paying occupations against women (Rubery, 1978), whereas feminists view it as a reflection of patriarchy (Hartman and Reskin, 1986). Unlike radical economists, mainstream economists consider pre-market discrimination in the preference-formation stage, arguing that the labour market cannot be considered the only reason for discrimination, another reason being socialization. Socialization means that men and women are brought up to have different preferences and attitudes. While this definition tells us why women are segregated in the labour market, it does not tell us why society undervalues women's skills and attitudes and how this societal discrimination accounts for discrimination in the labour market. Market skills mirror the preferences assigned by society to men and women before they enter the labour market. Socialization defines the typical choices for each sex, from household roles to education and type of work. If socialization limits women to specific fields of education and thus leads to specific limited occupations, overcrowding and depression of female wages will be the result.

Although perfect competition entails an efficient labour market and assumes that wages are determined on the basis of marginal productivity, it is different with segmentation theory. The institutional and labour market segmentation theory assumes that the labour market is segmented in a certain way, and that workers find it difficult to move from one segment to another. It assumes that institutions (e.g. unions and firms) play a leading role in the process of hiring, firing and promotion. Wages are therefore co-determined by market and institutional mechanisms. The best-known model reflecting these assumptions is the Dual Labour Market theory (Doeringer and Piore 1971) which assumes two distinct sectors “primary” and secondary”. Jobs in the primary sector are relatively better than those in the secondary sector in terms of wages, job security, working conditions and the opportunities for

workers to promote and enhance their skills and knowledge. Applying this theory to women's versus men's jobs implies that women work in secondary jobs with worse working conditions and less pay. Feminist economists entirely blame patriarchy for allocating women to secondary jobs, and this may evolve into ideological and union-prompted barriers, whereas radical economists ascribe this allocation to class interests, wages being outcomes of class bargaining. This would also explain why socialization has such a lasting influence on women's position in the labour market, and how this leads to pay inequalities with respect to men. Both patriarchy and socialization create sorting mechanisms that give women a lower probability of accessing primary jobs, thus causing discrimination. Briefly, the Dual Labour Market theory, patriarchy and socialization have all contributed to describing how segregation implies wage discrimination. On the other side, there are also theories that deny the link between segregation and wage discrimination, even going so far as to theorize that segregation protects women from discrimination. Becker's (1971) Taste-Based Discrimination model assumes that some employers have a taste for discrimination against women and believe that they incur disutility if they hire more women. This prejudiced employer rationally indulges his taste for discrimination by only hiring men due to refusing to hire equally productive but cheaper women. However, this theory faced severe criticism since in an efficient labour market there is a high probability of finding unprejudiced employers who benefit from hiring women at lower cost as they are less in demand by prejudiced employers. This earns them more profit, making unprejudiced employers more common in the long run. This indicates that in the Taste-Based Discrimination model, segregation is a way of avoiding the question of discrimination.

The Compensating Wage Differentials model (Rosen, 1986) is another neo-classical-based theory that arose from studying why women accept poorly paid jobs. According to this model, women prefer jobs with good working conditions and good fringe benefits, like health insurance and childcare. They therefore trade low monetary pay for other non-monetary rewards. In Human Capital theory (Mincer and Polachek, 1974), women's choices of occupations land them in occupations requiring lower investment in human capital and thus lower productivity. Through their own choices, women therefore end up in low-pay occupations. Thus we see that the three theories: Becker's Taste Discrimination model, the Compensating Wage Differentials model and the Human Capital theory, rule out wage discrimination in the presence of segregation.

The Pollution theory (Goldin, 2002) revisits Becker's Taste Discrimination model with regard to asymmetric information about the skills and capacities of women. Only median values of women's productivity-related characteristics are known. Women's integration into the labour force is positively related to employers' and male workers' familiarity with women's work skills/characteristics. Men consider that women's access to jobs in specific occupations (due to technological change and less need for male-related characteristics such as physical power) means that the minimum skills required for those occupations have been downgraded, diminishing the prestige of those occupations. Thus men are against women working in male-dominated occupations. In order to overcome men's opposition, employers create two distinct occupations with similar levels of skills for men and women. However, discrimination occurs in the adjustment period, leading to overcrowding of women in occupations that do not require highly-paid skills. The Pollution theory makes the neoclassical assumption of perfect

competition seem plausible by assuming imperfect information about women's skills and an adjustment lag. It provides a theoretical foundation for the argument that not all segregation eventually leads to discrimination.

In line with the Pollution theory's assumption of imperfect information, England (2004) attributes the matching of high-paying occupations with men to lack of information about the skills of women. Bettio (2008) argues that wages are determined on the basis of the importance of the position in the production structure, more than on productivity, namely that "damage potential" plays a critical role in weighing the value of a position in the structure of an organization. For example, since the ineptitude of a manager causes more damage than that of a production line worker, employers will not run the risk of filling critical positions with employees about whose skills and ability they have imperfect information.

Sociologists believe that individual preferences are socially constructed via factors including family, social institutions and labour market. These preferences reflect sex-based stereotypes, which matter because they generally prescribe appropriate behaviour. In the absence of information on productivity characteristics, to proxy this information labour markets may refer to sex-based stereotypes (Mayrhofer et al., 2009), such as the Statistical Discrimination theory which assumes that women's presence at work is more likely than that of men to be discontinuous (Phelps, 1972). Akerlof and Kranton (2000) introduced Identity theory which adds sex-based stereotypes as a new dimension to the standard utility function. It adds a vector of socially constructed prescription to the standard utility function, making its value a function of individual characteristics as well as socially assigned categories (men versus women). This results in different utility functions for men and women. The vector of social prescription defines the ideal characteristics of men and women: the closer individual behaviour is to these socially defined ideal characteristics, the higher the identity function. According to the theory, men and woman can chose between the occupations of men M and women W, and gain utility V. Non-conforming women (who choose M) lose *Is* utility, and men who do not conform lose *Io* utility at cost *C* for other male co-workers. Non-cooperating men add further loss *L* to the utility of non-conforming and also reduce worker productivity. The final decision to engage women in male-dominated occupations (de-segregation versus re-segregation) depends on the values of *Is, Io, C* and *L.*

Although developed countries struggle against occupational segregation by removing legal bans and mitigating entry barriers to the labour market, this does not eliminate covert opposition to women (Mayrhofer et al., 2009). Such opposition may be found in organizational practices, especially in selection and promotion mechanisms that tend to favour men. Baldwin et al. (2001)'s *hierarchical theory* is built on Becker's taste theory and human capital hypothesis, but admits a variety of worker abilities and "self-inflicted" discrimination, equating segregation with hierarchical segregation. It assumes that human capital is needed to climb the occupational ladder, and that the net return on investment in human capital is positive. This theory postulates that if the distribution of abilities and the numbers employed are the same for both sexes, then segregation prevents discrimination. If this condition is relaxed, women for example integrate less in the labour market due to housework, and some women have to manage and supervise men. But women on a higher rung of the occupational ladder have to compensate men for their distaste from their own rent. This compensation

depends on the level of distaste, the wage level for men's occupations, and the number of men supervised. Since the net return on investment in human capital is positive, and this human capital is a key factor for climbing the occupational ladder, it means that a wage gap exists between rungs of the hierarchy and the wage penalty that women have to pay to maintain their supervisory role increases as they rise in the occupational hierarchy. This high penalty for the top rungs explains why there are fewer women than men in these positions.

Reservation wages are very much influenced by the income role of family members. Bettio (2008) attributes the low reservation wages of women to their low income role in the family. Women also have a weaker bargaining position because of their unequal commitment to maintaining family income. This adds to the reasons why women are cheaper in the labour market and more likely to be found in labour-intensive jobs with low added value per hour of work. Badgett and Folbre (2003) wrote about how the marriage market interacts with the labour market, explaining that the income role gives rise to self-inflicted discrimination via under-investment in human capital. The income role of family members as well as the association between gender and occupation are socially prescribed. The incomes of the partners are pooled and the share of each partner is considered exogenous. This pooled/combined income is a function of the return on human capital. If society weighs men's income more than women's, then the combined income will be greater if he invests more in human capital. This social devaluation of women's income role in the family leads to lower skills and abilities due to under-investment in human capital; thus women end up in low-paying occupations.

1.3 Data sources and description

Our analysis relied on three waves of labour surveys administered to Palestinian households across the West Bank, including East Jerusalem and the Gaza Strip. These labour surveys covered the years 2002, 2012 and 2018 and were facilitated by the Palestinian Central Bureau of Statistics.[1] The data generated in the three waves was drawn from 76,525, 110,506 and 22160 respondents, respectively, and included information on their demographic, human-capital and job characteristics.

The demographic characteristics included marital status, age and refugee status; human-capital characteristics included education and tenure; job characteristics included firm size, industry, occupation and union membership.

Our sample used the data of current employees in the private and public sectors (5403 individuals), and excluded that of 234 self-employed, workers in the Israeli labour market and employees of local NGOs or international organizations and foreign governments such as embassies. Data of workers reporting only self-employed income was also excluded because their income data is known to be less reliable. Workers in Israel were excluded because they work in another differently structured labour market. Workers in international organizations and NGOs were also excluded because they were a very minor portion of the sample (157

[1] The Palestinian Central Bureau of Statistics can be accessed at www.PCBS.gov.ps

workers). Thus the study was able to focus on a comparison between public and private sectors.

Table 1. 1: Distribution of workers by type of organization

Type of organization	Number of workers
National Government and local authorities	1,293
Private sector*	4,110
Foreign government	8
International institutions including UNRWA	115
Non-profit organizations	42
Private households	69
Total	**5,637**

* Workers are classified in the private sector if they described their employer as a private for-profit organization.
Source: Palestinian Central Bureau of Statistics, Labour force survey, 2018. Own calculations.

1.4 Palestinian labour market dynamics

Dramatic changes took place in the structure of the Palestinian labour market between 2002 and 2018, changes that reflect greater willingness of women to work. The female labour force participation rate increased from 10.4% in 2002 to 16.8% in 2018. Women's participation in the public sector witnessed a dramatic increase to about one quarter of all employment in the public sector (23.6%). This sharp increase of women in the public sector reflects changes on both the supply and demand sides of the labour market equation, and a leap in women's skills and capacity to undertake tasks and challenges in the public sector and to compete with men (Supply side). Another change in the same period was more family-friendly working conditions, making it easier for women to work outside the home.

An increase in investment in the education of women also reflects a greater tendency of women work outside the home. The gap in average years of education between men and women fell from 1.3 years in favour of men in 2002 to 0.1 years in favour of women in 2018.[2]

[2] Average years of education were 10.06 years for men and 10.1 years for women in 2018, compared to 9.6 years for men and 8.1 years for women in 2002.

Table 1. 2: Comparison of employment status by gender

	Men			Women		
Employment status	**2002**	**2012**	**2018**	**2002**	**2012**	**2018**
Employed	41.35	44.41	44.61	8.61	10.33	8.62
Private	88.0	88.5	87.8	12.0	11.5	12.2
Public	82.4	77.5	76.4	17.6	22.5	23.6
Unemployed	21.73	11.66	14.89	1.77	4.48	8.21
Out of labour force	36.91	43.92	40.5	89.63	85.2	83.16
Total	100	100	100	100	100	100
No. observations	**38733**	**56205**	**11119**	**37792**	**54301**	**11047**

Source: Palestinian Central Bureau of Statistics, Labour force survey 2002, 2012 and 2018. Own calculations.
Note: The overall employment rate includes all employees in all sectors (private, public, international organizations, NGOs and those working in the Israeli labour market).

Women showed a higher pace of movement between sectors than men. Men showed a more static distribution of employment across sectors (Table 1.3). Women often moved from unpaid jobs such as agriculture to paid jobs in manufacturing and services. This could be attributed to women having more skills or to better/more education/training for women."

Table 1. 3: Gender distribution of employment across industries

	Men			Women		
Industry	**2002**	**2012**	**2018**	**2002**	**2012**	**2018**
Agriculture	12.4	8.9	6.6	30.3	23.7	7.7
Manufacturing	13.7	12.6	14.4	8.1	8.5	9.9
Construction	12.8	17.3	21.9	0.2	0.3	0.3
Commerce, hotels and restaurants	22.3	21.9	25.0	7.2	8.4	12.4
Transport, storage and communications	6.5	7.6	7.1	0.4	1.1	2.4
Services	32.3	31.7	25.0	53.8	58.0	67.3
Total	100	100	100	100	100	100
No. observations	**16,017**	**24,963**	**4,702**	**3,224**	**5,607**	**935**

Source: Palestinian Central Bureau of Statistics, Labour force survey, 2002, 2012, and 2018. Own calculations.

The improvement in the quality of female workers was also clear from women's advance into more qualified jobs. Types of occupation are classified according to level of complexity and skills (Table 1.4). The employment distribution of women shows that the percentage of women employed in higher-skilled occupations (managerial and professional) increased from 41.2% in 2002 to 61.3% in 2018.

Table 1. 4: Ten-year comparison of gender distribution of employment across occupations

	Men			Women		
Occupation	2002	2012	2018	2002	2012	2018
Legislators, senior officials and managers	4.44	5.06	3.66	2.37	4.14	4.37
Professionals, technical, associate and clerks	18.12	21.77	22.09	41.18	49.10	61.26
Service, shop and market workers	19.75	19.99	19.76	7.54	11.15	13.16
Skilled agricultural & fishery workers	11.65	5.24	2.82	36.56	19.06	4.50
Craft and related trades workers	19.23	18.10	21.46	5.92	6.02	5.41
Plant and machine operators, and assemblers	9.23	9.93	10.44	0.87	3.61	3.30
Elementary occupations	17.58	19.92	19.77	5.55	6.92	8.01
Total	100	100	100	100	100	100
No. observations	**16,017**	**24,963**	**4,702**	**3,224**	**5,607**	**935**

Source: Palestinian Central Bureau of Statistics, Labour force survey, 2002, 2012, and 2018. Own calculations.

1.5 Gender-based occupational segregation

The literature distinguishes two kinds of occupational segregation. Horizontal segregation occurs when women's or men's occupations are concentrated in specific sectors, whereas vertical segregation occurs when women or men occupy low positions in the occupational hierarchy. Horizontal segregation mainly reflects the recruitment process, while vertical segregation reflects the promotion process in a given occupation. As previously described, the literature regards segregation as a causal factor of discrimination. We now document occupational segregation in the Palestinian labour market, after which we investigate the association between segregation and discrimination.

The Dissimilarity Index and Karmel-MacLachlan index are the most commonly used to measure the degree of occupational segregation. The Dissimilarity Index (Carillo et al., 2012) measures the percentage of men or women that must be removed without replacement in order to get rid of segregation. It was introduced by Duncan and Duncan (1955), and is defined as

$$D = \frac{1}{2}\left|\frac{F_j}{F} - \frac{M_j}{M}\right|$$

where F_j and M_j denote the number of women and men employed in occupation j, whereas F and M indicate the total number of female and male workers employed. The dissimilarity index takes a value between 0 (perfect integration) and 100 (complete segregation) and can be seen as the percentage of each group that has to be removed, without replacement, for segregation to disappear (See e.g. Dolado et al., 2002).

The Karmel-MacLachlan index (Carillo et al., 2012) measures the percentage of either men or women who need to be reallocated and replaced in order to get rid of segregation.

Karmel-Maclachlan (1988) defined the index as:

$$I_p = \frac{1}{N}\left|F_j - a(M_j + F_j)\right|$$

where N and a denote the total employment and share of women, respectively. This index measures how much female employment in each employment category (F_j) departs from the number of women, equal to $a(M_j + F_j)$, who would be employed in occupation j without segregation.

Tracking these segregation indices for the years 2002, 2012 and 2018 showed a decreasing trend in occupational segregation in the private and public sectors (Table 1.5). Although the private sector showed a reduction in occupational segregation, it still demonstrated a higher level of segregation than the public sector. The dissimilarity index tells us that 40.7% of men or women had to change their occupations in the private sector for segregation to disappear; the figure for the public sector was 18.1%. The difference between the two sectors is confirmed by the Karmel-Maclachlan index. This result was expected and is consistent with Mora and Ruiz-Castillo (2004) and Dolado et al. (2002), who found higher gender occupational segregation in the private sector than in the public sector in Spain, USA and EU.

Table 1. 5: Ten-year comparison of Duncan and Karmel-Maclachlan indices of gender-based occupational segregation by sector

Sector	Year	$\frac{1}{2}\left\|\frac{F_j}{F} - \frac{M_j}{M}\right\|$	$\frac{1}{N}\left\|F_j - a(M_j + F_j)\right\|$
Private	2002	45.69	9.19
	2012	42.56	10.34
	2018	40.73	8.71
Public	2002	41.56	17.81
	2012	13.57	6.66
	2018	18.14	4.36

Source: Palestinian Central Bureau of Statistics, Labour force survey, 2002, 2012, and 2018. Own calculations.

Indices of segregation were also computed for the different occupations (Table 1.6). The results indicate that most private sector segregation concerns professional positions, followed by craft and trade workers, then elementary positions. Segregation in the public sector is mainly due to gender differences in professional positions and among service, shop and market workers. These results indicate that the private sector practises both types of segregation (horizontal and vertical), while in the public sector segregation tends to be more vertical than horizontal.

Although zero segregation is an optimal target, it still does not ensure zero wage discrimination. The latter may continue in a perfectly integrated labour market. Conversely, a perfectly segregated labour market need not entail wage discrimination. Economists use wage discrimination to reflect employer prejudice. The economic definition accepts "separate but equal wage jobs" as long as there is no discrimination in pay. Here we test the association

between occupational segregation and gender pay gap, which is taken as a measure of discrimination, then measuring the detrimental effect of discrimination on women's employment.

Table 1.6: Duncan and Karmel-Maclachlan indices of gender-based occupational segregation in private and public sectors in Palestine

Occupation	M_j	M_j/M	F_j	F_j/F	$\frac{1}{2}\left\|\frac{F_j}{F}-\frac{M_j}{M}\right\|$	$\frac{1}{N}\left\|F_j - a(M_j+F_j)\right\|$
Private						
Legislators, senior officials and	130	3.31	12	2.21	0.55	0.12
Professionals, technical, Associate	336	8.56	238	43.75	17.59	3.76
Service, shop and market Workers	839	21.38	124	22.79	0.71	0.15
Skilled agricultural & fishery	141	3.59	42	7.72	2.06	0.44
Craft and related trades workers	1,063	27.09	49	9.01	9.04	1.93
Plant and machine operators, and assemblers	498	12.69	31	5.70	3.50	0.75
Elementary occupations	917	23.37	48	8.82	7.27	1.56
$(N = 4468, a = 0.121755)$					D= 40.73	I_p=8.71
Public						
Legislators, senior officials and	46	4.56	18	5.79	0.61	0.23
Professionals, technical, Associate	718	71.16	270	86.82	7.83	3.35
Service, shop and market workers	148	14.67	0	0.00	7.33	0.40
Skilled agricultural & fishery	0	0.00	0	0.00	0.00	0.00
Craft and related trades workers	13	1.29	0	0.00	0.64	0.04
Plant and machine operators, and assemblers	22	2.18	0	0.00	1.09	0.06
Elementary occupations	62	6.14	23	7.40	0.63	0.28
$(N = 1320, a = 0.235606)$					D= 18.14	I_p=4.36

Source: Palestinian Central Bureau of Statistics, Labour force survey, wave 2018. Own calculations.

Note: The segregation indices are based on the two-digit ISCO classification of occupations. If we use the three-digit classification, the same indices for the private sector become D= 62.05 and I_p=12.7 and for the public sector, D= 60.5 and I_p=22.2.

1.6 Impact of education on occupational segregation

As noted earlier, since mainstream economists consider pre-market discrimination in the stage of preference formation, the labour market cannot be considered the only reason for discrimination. This is reflected in the concept of socialization, according to which men and women are raised with different preferences and attitudes from household roles to education. This societal discrimination of male and female preferences and attitudes accounts for discrimination in the labour market. If socialization limits women to specific fields or levels of education and thus leads to specific and limited types of occupation, women will end up in overcrowded occupations. Skills in the labour market mirror the preferences assigned by society to men and women before they enter the labour market. Accordingly, studying the role of education in occupational segregation provides insights into the factors that the Palestinian government could prioritize to mitigate occupational segregation.

1.6.1 Estimation methodology

The impact of education is measured by estimating the probability of educated individuals ending up in more gender-integrated occupations. This requires two layers of classification of occupations, the first based on gender and the second on skills. The gender-based classification splits occupations into three groups: female-dominated occupations where women are at least 60% of all employees, male-dominated occupations where men are at least 60% of all employees, and gender-integrated occupations where men and women are 40 to 60% of all employees (See classification of jobs in Table 4 in the annex).

The skills-based classification applies to the groups of occupations and splits occupations into skilled versus non-skilled. This classification uses the International Standard Classification of Occupations (ISCO-08). Non-skilled occupations are all occupations listed by ISCO-08 in the first and second levels of skills which include cleaners, freight handlers, garden laborers, kitchen assistants, butchers, bus drivers, secretaries, accounting clerks, sewing machinists, dressmakers, shop sales assistants, police officers, hairdressers, building electricians and motor vehicle mechanics. Skilled occupations include those listed in ISCO-08's third and fourth levels of skills which include shop managers, medical laboratory technicians, legal secretaries, commercial sales representatives, diagnostic medical radiographers, computer support technicians, broadcasting and recording technicians, sales and marketing managers, civil engineers, secondary school teachers, medical practitioners, musicians, operating theatre nurses and computer systems analysts. We therefore further split the classification by level of gender integration (male dominated, female dominated, gender integrated) in order to understand the extent to which gender segregation benefits men and women.

Two types of analysis are carried out: i) the Multinomial Logit model to ascertain how vertical advancement in education influences horizontal occupational segregation in skilled and non-skilled occupations, ii) the Ordered Logit model to ascertain how vertical education influences vertical occupational segregation (Long & Freese, 2006).

The labour survey data provides information on the level of education but not on specialization. Our analysis in this paper is therefore limited to vertical advancement through education and the extent to which it affects occupational segregation. For the Multinomial Logit model, we use ten levels of education (illiterate, can read and write, elementary, preparatory, secondary, associate diploma, B.A, higher diploma, master's degree and Ph.D). For the Ordered Logit model, we grouped levels of education into three categories: Tawjihi[3] or less, bachelor's degree or higher diploma, and master's degree and above.

For the Multinomial Logit model, gender-integrated occupations were treated as the base outcome after grouping the two levels of skills; the other types were left unchanged. The model was run once for each sex. The covariates included in the model control for: i) personal characteristics (education, marital status, age and tenure); ii) the characteristics of society

[3] Tawjihi is the general secondary school certificate. It is the last stage of school education.

in order to control for societal definition of the roles of men and women, including region (West Bank versus Gaza Strip) and locality of residence (urban, rural and camps); iii) the type of labour market according to the International Standard for Industrial Classification (ISIC).

1.6.2 Labour characteristics of gender-classified occupations

The labour data shows a greater tendency of men than women to work in segregated occupations. The employment distribution shows that 90.7% of employed men work in male-dominated occupations, and 28.9% of women work in female-dominated occupations (Table 1.7). Around two thirds of working women are recruited in skilled occupations (76.2%) compared to 44.2% of men. All non-skilled occupations are dominated by men. This can be attributed to the relatively smaller number of working women and their much higher level of education. These two facts together make it easier for women to spread across occupations where their skills/education are needed.

Table 1.7: Employment distribution of men and women by type and skill level of occupation

Occupation type and level	Male	Female
Skilled female-dominated	2.78	28.91
Non-Skilled female-dominated	0.0	0.0
Skilled gender-integrated	5.85	22.90
Non-Skilled gender-integrated	0.71	3.50
Skilled male-dominated	35.53	24.41
Non-Skilled male-dominated	55.12	20.28
Total	100	100
Observations	**4,528**	**799**

Source: Palestinian Central Bureau of Statistics, Labour force survey, 2018. Own calculations.

Nearly a third (28.9%) of women who work in skilled female-dominated occupations and 24.4% of those in skilled male-dominated occupations benefit from this segregation in terms of wages and job security. Women working in skilled female- and male-dominated occupations are paid 9.7% and 8.9% more, respectively, than average working women. With respect to job security, women working in skilled female-dominated occupations have higher status than those in skilled male-dominated occupations; they more often belong to workers/vocational unions and work under the protection of written contracts. This job security is higher for women with long years of tenure than for women with average tenure (Table 1.8). This descriptive analysis anticipates aspects to be examined in the following sections, in particular that horizontal segregation may benefit women rather than harming them.

Table 1.8: Wages, tenure and average years of education by gender and occupational type and level

	Mean	Female-Dominated		Gender-Integrated		Male-Dominated	
		Skilled	Non-Skilled	Skilled	Non-Skilled*	Skilled	Non-Skilled
Female Employees							
Average daily wage (NIS) Ψ	89.6	98.3	N/A	90.0	N/A	97.6	57.7
Tenure (Years)	8.9	10.8	N/A	8.0	N/A	7.4	7.6
Average years of education	9.7	15.6	N/A	15.4	N/A	12.9	8.8
Affiliated to workers/vocational union (% of total employees)	25.5	35.0	N/A	41.6	N/A	19.6	4.2
Contract			N/A		N/A		
Written	73.6	85.4	N/A	78.9	N/A	68.0	39.8
Verbal	6.7	3.0	N/A	7.0	N/A	8.2	15.5
No Contract	19.4	11.7	N/A	14.7	N/A	23.8	44.7
Male Employees							
Average daily wage (NIS)	120.7	136.3	N/A	117.4	106.5	102.4	131.1
Tenure (Years)	8.9	13.8	N/A	10.9	6.0	10.3	7.3
Average years of education	9.9	16.6	N/A	15.5	9.5	12.0	10.0
Affiliated to workers/vocational union	17.6	50.3	N/A	51.7	3.1	17.9	11.6
Contract (% of total employees)			N/A				
Written	42.2	96.1	N/A	93.4	0.0	68.6	13.5
Verbal	13.4	0.0	N/A	1.2	50	6.8	20.5
No Contract	44.4	3.9	N/A	5.3	50	24.6	66.0

Source: Palestinian Central Bureau of Statistics, Labour force survey, wave 2018. Own calculations.

Ψ New Israeli Shekel

- The sample of women in non-skilled gender-integrated occupations is very small and is not included in this table to avoid lack of accuracy in representing the Palestinian population.

1.6.3 Estimation results

The results of the Multinomial Logit model are shown in Tables 1.9 and 1.10. Measures of goodness of fit indicate that the model performed well. The likelihood ratio test indicates that the model is significant at 0.01 level, and McFadden R^2 is acceptably high at 0.329 for women and 0.446 for men.

Since gender-integrated occupations are the baseline group for comparison, the results show that vertical advancement in education by men and women has a significant positive effect on mitigating occupational segregation, especially in male-dominated occupations. For example, a one-step increase in education by women makes them 0.182 less likely to work in skilled male-dominated jobs and 1.616 less likely to work in the non-skilled male-dominated occupations. However, this analysis considers all levels of education and does not shed light on higher levels of education in particular. We therefore measured marginal effect for workers who have a B.A. and above (B.A., Higher Diploma, Master and PhD), in order to

obtain more precise information on where people with a higher level of education are more likely to be found. The results show that for women, having a higher level of education does not make any significant effect on where women are likely to work, unlike for men, where better education makes them less likely to end up in male-dominated occupations but favours gender-integrated ones. We therefore conclude that better education only mitigates horizontal occupational segregation for men and only affects male-dominated occupations.

The expected probability of being hired at an occupational level is calculated for men and women and the three levels of education. Table 1.11 shows that the probability of being in a higher-ranked occupation is positively associated with better education, and this holds for both men and women. For example, men with a master's degree and above are 18.9% more likely to be in top-ranked occupations than are men with Tawjihi and less. The same applies to women. This supports the conclusion that polices that lead to better education for women help mitigate vertical segregation and hence its associated detrimental effects.

Table 1.9: Multinomial Logit results for women being hired in different types of occupations (gender-integrated occupations are the baseline category)

	Pr(Occupation=Skilled Female-Dominated)		Pr(Occupation=Skilled Male-Dominated)		Pr(Occupation=Non Skilled Male-Dominated)	
Variable	**Coefficient**	**Marginal Effect***	**Coefficient**	**Marginal Effect**	**Coefficient**	**Marginal Effect**
Education	0.123	0.0159	-0.182*	-0.0309	-1.616***	-0.0002
Tenure	0.000	0.0001	-0.002	-0.0004	-0.004	0.0000
Age	0.111	0.0106	0.013	-0.0003	-0.007	0.0000
Age square	-0.001	-0.0001	0.000	0.0001	0.001	0.0000
Married	0.548**	0.0593	-0.257	-0.0517	0.771	0.0001
Other social status	-0.138	-0.0201	0.309	0.0510	0.064	0.0000
Region	-0.349	-0.0308	-0.162	-0.0177	-2.980***	-0.0003
Rural	-0.008	0.0142	-0.706*	-0.1096	0.696	0.0001
Camp	-0.026	0.0011	-0.174	-0.0266	0.946	0.0001
Manufacturing	-15.139	-1.5100	1.049	0.4858	-16.035	-0.0014
Construction	-15.913	-1.2228	-16.012	-2.1516	-21.435	-0.0016
Commerce, hotels and restaurants	-15.692	-1.5753	1.572	0.5790	-23.984	-0.0021
Transport, storage, and communication	-15.492	-1.5327	0.490	0.4064	-22.600	-0.0020
Services	-0.317	-0.0375	0.308	0.0550	-22.241	-0.0021
CONSTANT	-2.477		0.004		30.690	
Obs.		599				
McFadden Adj. R2		0.329				
Log likelihood		-533.13				
Log likelihood, restricted		-794.92				
Model Chi-square		523.57				

Source: Palestinian Central Bureau of Statistics, Labour force survey, 2018. Own calculations.

* Marginal effect is calculated for individuals who have a B.A. and above with all variables at their mean values.

Table 1.10: Multinomial Logit results for men being hired in different types of occupations (gender-integrated occupations are the baseline category)

	Pr(Occupation=Skilled Female-Dominated)		Pr(Occupation=Skilled Male-Dominated)		Pr(Occupation=Non Skilled Male-Dominated)	
Variable	**Coefficient**	**Marginal Effect**	**Coefficient**	**Marginal Effect**	**Coefficient**	**Marginal Effect**
Education	0.406***	0.000	-0.549***	-0.120***	-1.204***	-0.025***
Tenure	0.003*	0.000	0.003**	0.001**	-0.002	0.000**
Age	0.006	0.000	0.108	0.025	0.088	0.001
Age square	0.000	0.000	-0.001*	0.000*	-0.001	0.000
Married	0.257	0.000	-0.339	-0.079	-0.296	-0.004
Other social status	0.979	0.000	-1.251	-0.283	-1.895	-0.035**
Region	-0.580**	0.000	0.337*	0.079	0.256	0.003
Rural	0.649**	0.000	0.259	0.059	0.318	0.005
Camp	0.172	0.000	0.068	0.014	0.248	0.006
Manufacturing	0.501	0.000	2.384*	0.565***	1.217	0.005
Construction	0.595	0.000	1.688	0.391*	1.727*	0.026
Commerce, hotels and restaurants	0.335	0.000	3.362***	0.824	-0.751	-0.057***
Transport, storage, and communication	-2.899	0.000	-0.419	-0.077	-2.178*	-0.052***
Services	15.506	0.000	0.665	0.206	-4.086***	-0.114
CONSTANT	-19.087		1.252		8.225***	
Obs.		3079				
McFadden Adj. R2		0.446				
Log likelihood		-1726.30				
Log likelihood, restricted		-3113.93				
Model Chi-square		2775.26				

Source: Palestinian Central Bureau of Statistics, Labour force survey, 2018. Own calculations.

Table 1.11: Estimated probability of ending up in a given occupation as a function of level of education

Occupation	Women				Men			
	Tawjihi or less	B.A./ H.Diploma	Master and above	Difference	Tawjihi or less	B.A./ H.Diploma	Master and above	Difference
	(1)	(2)	(3)	(3)-(1)	(4)	(5)	(6)	(6)-(4)
Legislators, senior officials and managers	0.0069	0.0548	0.1798	0.1729	0.0056	0.0484	0.1951	0.1895
Professionals, technical, associate and clerks	0.2444	0.7028	0.7510	0.5066	0.1994	0.6348	0.7296	0.5302
Service, shop and market workers	0.1853	0.1805	0.0637	-0.1216	0.1562	0.1887	0.0657	-0.0905
Skilled agricultural & fishery workers	0.0047	0.0043	0.0012	-0.0035	0.0040	0.0045	0.0013	-0.0027
Craft and related trade workers	0.2198	0.0481	0.0041	-0.2157	0.2060	0.0820	0.0076	-0.1984
Plant and machine operators and assemblers	0.0740	0.0057	0.0001	-0.0739	0.0751	0.0168	0.0006	-0.0745
Elementary occupations	0.2648	0.0039	0.0000	-0.2648	0.3538	0.0248	0.0001	-0.3537

Source: Palestinian Central Bureau of Statistics, Labour force survey, 2018. Own calculations.

T-test is used to test whether the difference is significant. All differences are significant.

Each column presents the probability distribution based on level of education and therefore sums to one, while the difference column sums to zero.

1.7 Gender wage gap in Palestine

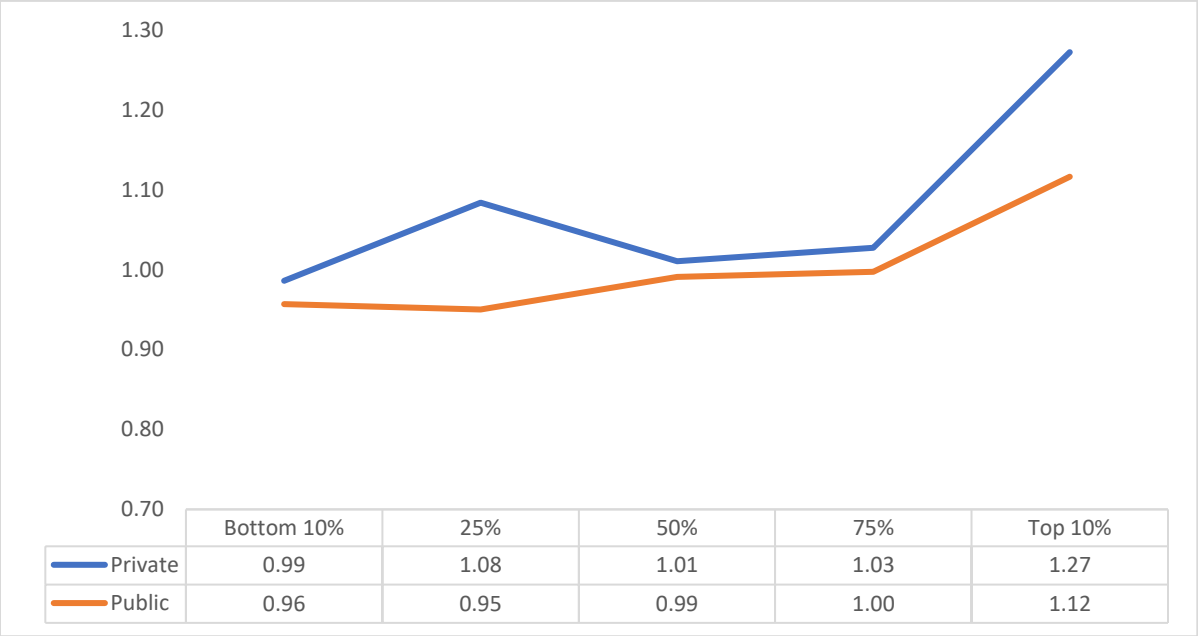
Having documented the pattern and extent of gender occupational segregation in Palestine, we now show the magnitude and sectoral distribution of the gender pay gap, later proceeding to investigate the relationship between the two by different econometric decomposition techniques, namely the Oaxaca Blinder average decomposition and the Di Nardo quantile decomposition.

Wage structure in the public sector is built in a political environment, whereas the private sector formulates its own wage structure based on the dynamic environment of the market. Moreover, antidiscrimination legislation may be more aggressively enforced in the public sector. Empirical studies show that gender pay gaps and vertical segregation are lower in the public sector than in the private sector. Arulampalam et al. (2007), Dell' Aringa et al. (2007) and Gregory and Borland (1999) found that the mean gender wage gap is considerably smaller in public sector jobs while the distribution of relative wages varies dramatically across sectors.

The men to women wage ratio provides evidence that the public wage structure is gender sensitive and that the Palestinian government has successfully applied antidiscrimination polices. On average, employed men who work in the public sector earn around USD 0.9 less than women per day (USD 30.41 versus USD 31.31). The gender pay gap is higher in the private sector, where men's average daily earning is USD 19.69 more than that of women (USD 37.31 versus USD 17.62). However, the average does not give a full picture of the pay gap. To compare the gender pay gap between low and high wage earners, Figure 1.1 shows wage levels at the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} percentiles, demonstrating that the gender pay gap in the public sector tends to be in favour of men as we rise in the wage distribution. In the bottom 10% of the wage distribution, the pay gap is in favour of women, reversing in the upper part, where men earn about 12% more than women. The picture is similar in the private sector, which shows a consistent fluctuation around the trend for all earning levels. However, the gap is relatively higher at the upper part of the distribution than at the bottom 10th percentile.

Although a gender pay gap exists in the private and public sectors, this still does not reflect the extent to which discrimination contributes to this gap. This and how segregation enforces discrimination are studied in the following sections.

Figure 1.1: Men to women daily earning ratio by sector



	Bottom 10%	25%	50%	75%	Top 10%
Private	0.99	1.08	1.01	1.03	1.27
Public	0.96	0.95	0.99	1.00	1.12

1.8 Determinants of the gender pay gap: the Oaxaca-Blinder decomposition

Here we examine the effect of vertical (horizontal) segregation on the gender pay gap. This helps us understand gender pay gaps in Palestine by analysing the effect of occupational segregation on the wages of men and women across sectors. Specifically, how important are gender differences in endowments such as demographic and human capital characteristics in explaining the gender pay gap? And is there a component of the gap that cannot be accounted for in terms of demographic and other observable personal characteristics of men and women? Finally, do the public and private sectors behave similarly in this respect?

The wage decomposition that follows relies on the techniques proposed by Blinder (1973) and Oaxaca (1973) which divide the wage differential between men and women into two parts: the part "explained" by differences in characteristics and endowments that have a direct effect on productivity, and the "unexplained" part that is expressed by the residual part of the econometric model. This unexplained part of the wage differential represents potential discrimination against women. The unexplained part of the pay gap should by no means be interpreted as the difference in wages due only to discrimination, but depends on unobserved covariates that explain the difference in wages but were not included in the model. This means that the unexplained part of the pay gap may include real discrimination as well as unobserved variables that were not

included in the model. For example, Card and Krueger (1992) studied the earnings of blacks and whites in the southern states of the United States and the lower coefficient of education of blacks compared to whites is attributed to lower quality schooling. So in this example, difference in coefficients does not reflect discrimination. This part of the paper focuses on the unexplained part of the decomposition with sector-based (public versus private) comparison.

The first step in the decomposition entails estimating wage equations, generally Mincerian type equations augmented with some additional covariates (Gregoir and Maury 2018, Gennaioli et al., 2013). Wage equations were run for the private and public sectors in the West Bank and the Gaza Strip. The right side of the logarithmic wage equation includes education (illiterate, can read and write, elementary, preparatory, secondary, associate diploma, B.A., higher diploma, master's degree, PhD), and tenure and age (in years) to control for the human capital accumulation, marital status (never married, engaged, married) and relationship to the family (head of the family, spouse, son\daughter, other relatives) to control for the fact that married women are less willing to participate in the labour market and devote more hours to the family, and heads of family are more willing to work to cover living costs. Occupation (managers, professionals, technicians and associate professionals, clerical support workers, services and sales workers, skilled agricultural, forestry and fishery workers, craft and related trades workers, plant and machine operators, and assemblers, and elementary occupations) to control for differences between occupations. The binary variables Contract (1 if the worker has a written contract, 0 otherwise) and Union (1 if the worker is a member of labour union, 0 otherwise) control for the fact that protected workers have more sustainable jobs and are more likely to be paid higher wages. The International Standard for Industrial Classification (ISIC) controls for differences in economic sectors. The binary variable Refugee (1 if the worker lives in a refugee camp, 0 otherwise) controls for social differences in Palestinian community structure that play a role in job opportunities and the number of working hours. Table 5 in the annex reports the estimation results for each region and sector. Estimated covariates conform to the theory in terms of expected sign and significance, but the negative signs of education, age (not significant) and union membership in the West Bank private sector wage equation are an exception.

The second step in the estimation involves decomposition of the gap into three components due to 'endowments', coefficients and residual factors. The endowments component accounts for differences in actual characteristics of men and women, while the coefficient component accounts for differences in the effects of these characteristics (observed covariates), and residual factors account for interaction of differences in endowments and coefficients. The last two components express the unexplained part of the gender wage gap and are interpreted as potential discrimination.

Table 1.12 shows that the mean difference in wages is large in the private sector on the West Bank and Gaza Strip, and this difference almost triples on the West Bank. However, the unexplained part of the wage gap in the private sector is larger in the Gaza Strip (126.1%) than on the West Bank (102.1%). As noted earlier, the unexplained part signals potential discrimination, indicating that the latter might be higher in the Gaza Strip. Although the mean difference in endowments is in favour of women, this difference is offset by the unexplained part. Here further investigation of the determining factors is needed and for implementation of antidiscrimination policies.

The results also differ between the private and public sectors. Although small, the difference is in favour of women in both regions (West Bank and Gaza Strip). We speculate that this may be due to the anti-discrimination policies implemented in the public sector.

It should also be noted that women's excellence in endowments is larger in the Gaza Strip, but this was completely offset in the private sector and partially in the public sector by the unexplained part of the pay gap which suggests higher potential discrimination in the Gaza Strip.

Table 1.12: Decomposition of the gender wage gap by sector and region

	West Bank		Gaza Strip	
	Private	Public	Private	Public
Offer wage differential Ψ	1.251	-0.075	0.402	-0.037
Due to endowments	-0.026	-0.006	-0.105	-0.049
Due to coefficients	1.060	0.026	0.939	0.082
Due to interaction[4]	0.217	-0.094	-0.432	-0.071

Source: Palestinian Central Bureau of Statistics, Labour force survey, wave 2018. Own calculations.
Ψ Wage difference is calculated in the logarithmic form.

1.9 Determinants of the gender wage gap: quantile decomposition

The gender wage gap tends to vary with the distribution of wages. In order to decompose the gap at various quantiles of the distribution, we use the model produced by Di Nardo et al. (1996) that enables us to obtain the counterfactual distribution of gender pay gap by maintaining the characteristics of men and only changing specific wage-related characteristics to be the same as those of women (Baron and Cobb-Clark, 2010). The model assumes that the sample is drawn from a population with joint

[4] The interaction term accounts for the fact that group differences in endowments and coefficients exist simultaneously.

distribution $f(w, X, g)$, where w is the daily wage rate, X the vector of wage-related covariates, and g the gender variable (0 for men, and 1 for women).

The conditional distribution of wages of men $f^0(w, X|g = 0)$ can be defined as the integral of the conditional density of wages over the wage-related covariates of men.

$$f^0(w) = \int_{X \in \Omega_X} f\,(w, X|g = 0).\, f_x(x|g = 0).\, \partial x$$

where Ω_X is the domain of individual wage-related characteristics, $f(.)$ is the wage distribution of men, conditional on the wage-related covariates, and $f_x(.)$ is the distribution of wage-related covariates among men.

By using the marginal distribution, we create the counterfactual distribution by isolating specific factors of the gender pay gap. Here we partition the wage-related covariates into four components (labour market characteristics (l), experience (e), educational attainment (h), and demographic characteristics (d)) and rewrite the conditional density of wages for men as:

$$f^0(w) = \int_l \int_e \int_h \int_d f\,(w|l, e, h, d, g = 0).\, f_l(l|e, h, d, g = 0).\, f_e(e|h, d, g = 0).\, f_h(h|d, g = 0)$$
$$.\, f_d(d|g = 0).\, \partial l.\, \partial e.\, \partial h.\, \partial d$$

By keeping the experience, educational attainment and demographic characteristics of men and entering the labour characteristics of women, we get the counterfactual distribution of men's wages. We compare it with the observed wage distribution for men, and we can decompose the gender pay gap at any quantile.

The counterfactual wage distribution of men having the same labour characteristics as women is:

$$f^A(w) = \int_l \int_e \int_h \int_d \psi_l f\,(w|l, e, h, d, g = 0).\, f_l(l|e, h, d, g = 1).\, f_e(e|h, d, g = 0)$$
$$.\, f_h(h|d, g = 0).\, f_d(d|g = 0).\, \partial l.\, \partial e.\, \partial h.\, \partial d$$

where $\psi_l = f_l(l|e, h, d, g = 0)/f_l(l|e, h, d, g = 1)$ which is the weighting function of the observed wages.

1.9.1 Estimation results

We are interested in investigating the role of gender-based occupational and industrial segregation on the distribution of the gender pay gap in the private and public sectors. We start by estimating the wage equation, excluding occupation and industry

in turn, then we repeat the estimation including occupation and industry in order to measure changes in explained versus unexplained components of the wage gap.

Table 1.13 indicates several points. First, the gender pay gap in the private sector decreases with increasing wages, but shows a leap in the top 10% of the wage distribution. The bottom and top of the wage distribution have similar characteristics in terms of advancement of women's endowments but show a pay gap in favour of men. Note that employees in the bottom part of the wage distribution are most likely working in the informal sector. The informal sector has unorganized wage structure, no enforcement of the minimum wage law, and depends heavily on the power of negotiation between the principal and the agent. The top part is better characterized, having formal types of employment enforced with written contracts, and bigger differences of endowments in favour of women, but men's endowments remain better evaluated (the mean difference in coefficients is in favour of men). Second, this better evaluation of men's endowments exists in both the private and public sectors throughout the entire pay gap distribution. Third, advances in women's endowments are higher in the public than the private sector. This relatively large advancement in endowments of women offsets the public sector's evaluation/treatment of endowments in favour of men and maintains the pay gap in favour of women except in the top 10% of the wage distribution (a better evaluation of men's endowments by the public sector outweighs women's advancement in endowments).

When occupational dummies are included in the private sector in order to proxy vertical rather than horizontal segregation, it has two effects. First, the gender pay gap increases in the bottom part but decreases in the upper part of the wage distribution. This supports the idea that vertical segregation results in overcrowding of women in low-paying occupations, and their advantage of endowments due to education is offset by a higher level of potential discrimination (unexplained pay gap). Second, the unexplained difference in wages increases in the bottom part from 102.4% to 110.3%, and in the upper part from 114.7% to 128.1%. Although the difference in endowments increases in favour of women, it is completely offset by the unexplained part of the pay gap. This high proportion of unexplained pay gap in the upper part of the wage distribution supports the idea that women employed in the private sector encounter a 'glass ceiling', while the increase in unexplained pay gap caused by including occupational dummies indicates that vertical segregation by gender is associated with a greater risk of discrimination.

The public sector results indicate that including occupational dummies raises the unexplained pay gap in the bottom part of the wage distribution from 94.4% to 131.6%. This high portion of unexplained pay gap is completely offset by women's advancement in endowments which maintains the pay gap in favour of women. Women's advancement in endowments declines as we rise in the wage distribution and turns in favour of men in the upper part. This decline in women's advancement of endowments (explained pay gap) reflects the increase in the unexplained part, albeit less dramatically in the upper part of the distribution. These results indicate that vertical segregation enforces potential discrimination with more effect in the lower part of the wage distribution.

Table 1.14 shows that the gender pay gap reflects a positive reduction in potential discrimination (reduction in the unexplained component) due to sectoral segregation, which may be taken to proxy horizontal rather than vertical segregation. This holds for both the private and public sectors, with a larger reduction in the private sector. In the private sector, for example, introducing dummies for industry reduces the unexplained component from 124.8% to 102.4% at the bottom of the gender pay gap distribution and from 114.7% to 87.7% in the upper part. In the public sector, the unexplained pay gap shows lower sensitivity, with a reduction from 108.0% to 94.4% at the bottom and from 207.3% to 202.3% in the upper part of the pay gap distribution. This high contribution of the unexplained component at the top of the pay gap distribution supports the idea that women are more likely to encounter a "glass ceiling" than "sticky floors".

These results lead us to several conclusions. First, both types of segregation (horizontal and vertical) exist in the private and public sectors. However, horizontal segregation tends to protect women from discrimination, while vertical segregation has a detrimental effect on the relative wages of working Palestinian women. Second, in the public sector, women have a better chance of competing with men because their advancement in endowments favours them in public gender-sensitive recruitment procedures, keeping the gender pay gap in their favour. Third, although the public sector enforces equal recruitment procedures, this does not eliminate covert opposition to promotion of women by men. Only further measures by the Palestinian government can mitigate the effect of vertical segregation.

Table 1.13: Decomposition of the gender pay gap by private and public sector and occupational segregation

Percentile	Occupation Excluded				Occupation Included			
	Raw Wage Gap	Due to Endowments	Due to Coefficients	Due to Interaction	Raw Wage Gap	Due to Endowments	Due to Coefficients	Due to Interaction
Private Sector								
10th Percentile	0.679	-0.016	0.666	0.029	0.702	-0.072	0.725	0.049
%	100	-2.40	98.10	4.3	100.0	-10.30	103.30	7.0
25th Percentile	0.640	-0.022	0.581	0.081	0.642	-0.052	0.594	0.099
%	100.0	-3.40	90.80	12.70	100	-8.10	92.50	15.40
50th Percentile	0.621	0.311	0.563	-0.253	0.647	0.376	0.639	-0.369
%	100	50.10	90.70	-40.70	100	58.10	98.80	-57.0
75th Percentile	0.578	0.174	0.623	-0.220	0.555	0.218	0.610	-0.273
%	100	30.10	107.80	-38.10	100	39.30	109.90	-49.20
90th Percentile	0.723	-0.105	0.901	-0.072	0.693	-0.196	0.982	-0.094
%	100	-14.50	124.60	-10.0	100	-28.30	141.70	-13.60
Public Sector								
10th Percentile	-0.107	-0.208	0.059	0.042	-0.095	-0.220	0.066	0.059
%	100	194.40	-55.10	-39.30	100	231.60	-69.50	-62.10
25th Percentile	-0.120	-0.158	0.049	-0.011	-0.118	-0.107	0.035	-0.046
%	100	131.70	-40.80	9.20	100	90.70	-29.70	39.0
50th Percentile	-0.061	-0.128	0.082	-0.015	-0.074	-0.051	0.060	-0.083
%	100	209.80	-134.40	24.60	100	68.90	-81.10	112.20
75th Percentile	-0.039	-0.119	0.119	-0.039	-0.027	0.020	0.121	-0.168
%	100	305.10	-305.10	100.0	100	-74.10	-448.10	622.20
90th Percentile	0.041	-0.044	0.211	-0.126	0.019	0.021	0.181	-0.183
%	100	-107.30	514.60	-307.30	100	110.50	952.60	-963.20

Source: Palestinian Central Bureau of Statistics, Labour force survey, wave 2018. Own calculations.

Table 1.14: Decomposition of the gender pay gap by private and public sector and sectoral segregation

Percentile	Private Sector							
	Industry Excluded				Industry Included			
	Raw Wage Gap	Due to Endowments	Due to Coefficients	Due to Interaction	Raw Wage Gap	Due to Endowments	Due to Coefficients	Due to Interaction
10th Percentile	0.648	-0.160	0.740	0.069	0.679	-0.016	0.666	0.029
%	100	-24.70	114.20	10.60	100.0	-2.40	98.10	4.30
25th Percentile	0.601	-0.120	0.711	0.009	0.640	-0.022	0.581	0.0081
%	100.0	-20.0	118.30	1.50	100	-3.40	90.80	1.30
50th Percentile	0.619	-0.039	0.720	-0.062	0.621	0.311	0.563	-0.253
%	100	-6.30	116.30	-10.0	100	50.10	90.70	-40.70
75th Percentile	0.596	-0.110	0.705	0.001	0.578	0.174	0.623	-0.220
%	100	-18.50	118.30	0.20	100	30.10	107.80	-38.10
90th Percentile	0.723	-0.105	0.901	-0.072	0.653	0.080	0.811	-0.238
%	100	-14.50	124.60	-10.0	100	12.30	124.20	-36.40
	Public Sector							
10th Percentile	-0.100	-0.209	0.059	0.049	-0.107	-0.208	0.059	0.042
%	100	209.0	-59.0	-49.0	100	194.40	-55.1	-39.3
25th Percentile	-0.117	-0.156	0.053	-0.013	-0.120	-0.158	0.049	-0.011
%	100	133.3	-45.3	11.1	100	131.7	-40.8	9.2
50th Percentile	-0.060	-0.128	0.083	-0.015	-0.061	-0.128	0.082	-0.015
%	100	213.3	-138.3	25.0	100	209.8	-134.4	24.6
75th Percentile	-0.032	-0.118	0.132	-0.046	-0.039	-0.119	0.119	-0.039
%	100	368.8	-412.5	143.8	100	305.1	-305.1	100.0
90th Percentile	0.041	-0.044	0.211	-0.126	0.044	-0.045	0.213	-0.124
%	100	-107.3	514.6	-307.3	100	-102.3	484.1	-281.8

Source: Palestinian Central Bureau of Statistics, Labour force survey, wave 2018. Own calculations.

1.10 Effect of wage discrimination on employment

Most empirical studies of wage discrimination build their analysis on the assumption that employers face perfectly inelastic labour supply (Cain, 1986). However, if the labour supply curves are not perfectly inelastic, wage discrimination induces women, who are a minority in the labour market, especially in developing countries, to leave the labour force. Many studies on wage effects of discrimination have assumed that men and women have the same taste for work (Cain, 1986). But recent studies abandon this assumption and address the different value that women and men ascribe to time. To tackle this difference, studies use Heckman's (1976) proposed selectivity-biased correction technique to control for between-group differences in the taste for work. If equally productive women and men are offered discriminatory wages, then part of the difference in the selectivity variable is a result of discrimination.

To estimate the effect of discrimination on the employment of women, we adopt the technique proposed by Baldwin and Johnson (1992) which separates Heckman selectivity-bias correction into discriminatory and non-discriminatory components.

Baldwin and Johnson's model is based on the assumption that employers offer wages to workers on the basis of their productivity, and the workers only accept the wage offer if it exceeds the reservation wage. If the non-discriminatory wage offered (W_i^{o*}) is a function of endowments (H) that determine worker productivity factors such as education, health and other skills, and the reservation wage (W_i^r) is a function of non-wage income (V) and personal characteristics (Z), then

$$W_i^{o*} = \beta_0 + \beta_1 H_i + \epsilon_i^o$$

$$W_i^r = \alpha_0 + \alpha_1 V_i + \alpha_2 Z_i + \epsilon_i^r$$

In a non-discriminatory labour market, the individual accepts work if

$$J_i^* = [(\beta_0 + \beta_1 H_i) - (\alpha_0 + \alpha_1 V_i + \alpha_2 Z_i)] > \mu_i$$

where $\mu_i = \epsilon_i^r - \epsilon_i^o$.

Therefore, the probability that an individual accept work is

$$\Pr(individual\ i\ works) = \Pr(\mu_i < J_i^*) = \Pr(\mu_i/\sigma < J_i^*/\sigma) = \Phi(J_i^*/\sigma).$$

where σ is the standard deviation of the difference in the errors of the offered and reservation wages and Φ is the cumulative density function of a standard normal variable.

In the discriminatory world, the monetary equivalent of employers' taste for discrimination (d) is subtracted from the mean offer wage to women, which reduces the offer wage–reservation wage difference ($\bar{J}_F$).

$$\bar{J}_F = (\overline{W}_M^0 - d) - \overline{W}_M^r.$$

The more prejudiced the employer, the higher the taste for discrimination against women. This reduces the mean offer wage–reservation wage difference, making the jobs less attractive

to women, while on the other hand discrimination raises the mean offer wage for men and makes the jobs more attractive.

Let π_j be the probability of employment of an individual with average endowments, calculated by a probit function in the form

$$L = \prod_{i\in E}\left[\Phi(J_i\ /\sigma)\right].\prod_{i\in \bar{E}}\left[1-\Phi(J_i\ /\sigma)\right]$$

where E represents employed individuals and $\bar{E}$ unemployed individuals.

Observed offer wages are given by

$$\overline{W_j^o} = \beta_0 + \beta_1\overline{H_j} \qquad j = M, F.$$

Assuming that the non-discriminatory wage lies midway between the offer wage for men and women, the non-discriminatory wage can be written:

$$(\overline{W_j^o})^* = 0.5(\hat{\beta}_0^M + \hat{\beta}_0^F) + 0.5(\hat{\beta}_1^M + \hat{\beta}_1^F)\overline{H_j} \qquad j = M, F.$$

The non-discriminatory probability of employment $\pi_j{}^*$ is obtained by adding the difference between the wage offer and the non-discriminatory wage as follows

$$\pi_j{}^* = \Phi\left[\left(\frac{\bar{J}_J}{\sigma_j}\right) + \left(\frac{W_i^{o*} - \overline{W_j^o}}{\sigma_j}\right)\right].$$

Then the discriminatory difference in the probability of employment can be computed as

$$\boldsymbol{\xi} = \Delta\boldsymbol{\pi} - \Delta\boldsymbol{\pi}^* = (\boldsymbol{\pi_M} - \boldsymbol{\pi_F}) - (\boldsymbol{\pi}^*{}_{\boldsymbol{M}} - \boldsymbol{\pi}^*{}_{\boldsymbol{F}}) = (\boldsymbol{\pi_M} - \boldsymbol{\pi}^*{}_{\boldsymbol{M}}) + \left(\boldsymbol{\pi}^*{}_{\boldsymbol{F}} - \boldsymbol{\pi}\ \ {}_{\boldsymbol{F}}\right).$$

1.10.1 Estimation results

We are interested in measuring the cost of discrimination against women in the labour market in terms of the number of lost jobs women could have in the absence of discrimination. We ignore the industry in this part and focus on the region (West Bank versus Gaza Strip) to reflect the cost to women of the differences in economic structure and effectiveness of antidiscrimination polices in each region.

The technique proposed by Baldwin and Johnson (1992, 2000) relies on the Heckman selection model (Heckman 1976). It estimates the number of jobs for women lost by offering discriminatory wages. Jobs are lost because some women would work for a non-discriminatory wage but not for a discriminatory wage. There are three stages in the Baldwin and Johnson technique:

1. using the Heckman selection model, the average probability of employment of women is estimated in the presence of discriminatory wages;
2. the average probability of employment of women is estimated in the absence of discrimination;

3. the number of working-age women is multiplied by the difference between discriminatory and non-discriminatory probabilities of employment. The result reflects the estimated number of jobs lost because of discriminatory wages.

Table 1.15 reports the probability of employment $\boldsymbol{\pi}$ and the probability of employment in the absence of discrimination $\boldsymbol{\pi}^*$. The 0.9% difference in the probability of employment in the West Bank and 0.6% in the Gaza Strip reflect a low sensitivity of women to non-discriminatory wages. However, the figures report a loss of 1,688 jobs for women. The larger loss of jobs in the Gaza Strip is partly explained by the higher rate of discrimination and consequent larger decrease in female labour-force participation.

This low sensitivity of women's probability of employment to non-discriminatory wages supports the idea that Palestinian women's decisions to participate in the labour force are not solely determined by the labour market and may be attributed to pre-market discrimination (preference formation), such as household role, women's care work and partners' share of earnings. Interfamily inequalities of roles, responsibilities and share of earnings provide a more comprehensive explanation of Palestinian women's incentives to join the labour market than does discrimination in hourly wages. This requires further analysis at household level with more focus on the social aspects and testing of the premarket discrimination associated with occupational segregation and the pay gap.

Table 1.15: Effect of discrimination against women on employment by sector and region

	West Bank	Gaza Strip
$\pi_M \times 100$	47.1	25.9
$\pi_F \times 100$	11.9	4.3
$\pi_M^* \times 100$	46.4	25.9
$\pi_F^* \times 100$	12.8	4.9
Loss of jobs to women	473	1,215

Source: Palestinian Central Bureau of Statistics, Labour force survey, wave 2018. Own calculations.

1.11 Discussion and conclusions

In this paper we analysed occupational, employment and wage discrimination measured by the hourly pay gap in the Palestinian private and public sectors using labour survey data of 2018. Our results indicate that we cannot rule out discrimination in either sector, especially in the private sector. Employment discrimination in the public sector did not harm women as it did not create a pay gap. This suggests that the public sector may have effectively implemented antidiscrimination policies. The opposite holds for the private sector where discrimination is still substantial.

When we decomposed wages in the private sector, potential discrimination (unexplained pay gap) seemed to account for 110.3% of the wage gap in the bottom part of the wage gap distribution and up to 128.1% in the upper part. This, in turn, can be seen as evidence that women employed in the private sector encounter a "glass ceiling" rather than a "sticky floor".

We also analysed the relationship between investment in education and the probability of women being in segregated jobs. Generally, the effect of vertical education on horizontal desegregation comes only via men, while it positively affects vertical desegregation by enhancing the recruitment of women to high ranks and high-paying occupations. Investment in education can therefore mitigate the detrimental effects of vertical segregation.

Wage discrimination has a detrimental effect on women because jobs, which in the absence of discrimination would be occupied by women, are lost. If the pay gap is not offset by government subsides, discrimination will continue to transfer resources from women to men, especially from women who are heads of families.

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Appendix

Table 1: Duncan and Karmel-Maclachlan indices of gender-based occupational segregation by the private and public sector in the West Bank

	Occupation	M_j	M_j/M	F_j	F_j/F	$\frac{1}{2}\left\|\frac{F_j}{F}-\frac{M_j}{M}\right\|$	$\frac{1}{N}\left\|F_j - a(M_j+F_j)\right\|$
Private	Legislators, senior officials and managers	102	4.39	10	2.31	1.04	0.27
	Professionals, technical, associate and clerks	238	10.25	178	41.20	15.48	4.09
	Service, shop and market workers	570	24.54	102	23.61	0.46	0.12
	Skilled agricultural &fishery workers	105	4.52	37	8.56	2.02	0.53
	Craft and related trades workers	532	22.90	37	8.56	7.17	1.90
	Plant and machine operators, and assemblers	329	14.16	28	6.48	3.84	1.02
	Elementary occupations	447	19.24	40	9.26	4.99	1.32
	$(N = 2722\,, a = 0.156806$					D= 35.00	I_p=9.26
Public	Legislators, senior officials and managers	33	7.05	12	5.48	0.79	0.18
	Professionals, technical, associate and clerks	376	80.34	185	84.47	2.07	3.52
	Service, shop and market workers	12	2.56	0	0.00	1.28	0.07
	Skilled agricultural &fishery workers	0	0.00	0	0.00	0.00	0.00
	Craft and related trades workers	1	0.21	0	0.00	0.11	0.01
	Plant and machine operators, and assemblers	12	2.56	0	0.00	1.28	0.07
	Elementary occupations	34	7.26	22	10.05	1.39	0.48
	$(N = 1320\,, a = 0.318777)$					D= 6.91	I_p=4.32

Note: Occupations are ordered according to skills rated from 1-4 (ISCO-08).

Table 2: Duncan and Karmel-Maclachlan indices of gender-based occupational segregation by private and public sector in the Gaza Strip

	Occupation	M_j	M_j/M	F_j	F_j/F	$\frac{1}{2}\left\|\frac{F_j}{F}-\frac{M_j}{M}\right\|$	$\frac{1}{N}\left\|F_j - a(M_j+F_j)\right\|$
Private	Legislators, senior officials and managers	12	1.43	2	1.94	0.26	0.05
	Professionals, technical, associate and clerks	87	10.34	60	58.25	23.95	4.66
	Service, shop and market workers	224	26.63	18	17.48	4.58	0.89
	Skilled agricultural &fishery workers	34	4.04	5	4.85	0.41	0.08
	Craft and related trades workers	140	16.65	12	11.65	2.50	0.49
	Plant and machine operators, and assemblers	123	14.63	3	2.91	5.86	1.14
	Elementary occupations	221	26.28	3	2.91	11.68	2.27
	$(N = 2722\,, a = 0.156806$					D= 49.23	I_p=9.57
Public	Legislators, senior officials and managers	13	2.40	7	7.53	2.56	0.51
	Professionals, technical, associate and clerks	342	63.10	85	91.40	14.15	4.07
	Service, shop and market workers	136	25.09	0	0.00	12.55	1.57
	Skilled agricultural &fishery workers	0	0.00	0	0.00	0.00	0.00
	Craft and related trades workers	12	2.21	0	0.00	1.11	0.14
	Plant and machine operators, and assemblers	11	2.03	0	0.00	1.01	0.13
	Elementary occupations	28	5.17	1	1.08	2.05	0.23
	$(N = 1320\,, a = 0.318777)$					D= 33.43	I_p=6.65

Table 3: Duncan and Karmel-Maclachlan indices of gender-based occupational segregation by industry and region

	Industry	M_j	M_j/M	F_j	F_j/F	$\frac{1}{2}\left\|\frac{F_j}{F}-\frac{M_j}{M}\right\|$	$\frac{1}{N}\left\|F_j - a(M_j+F_j)\right\|$
Palestine	Agriculture	1,418	10.35	112	6.24	2.055	0.42
	Manufacturing	2,441	17.81	336	18.73	0.46	0.09
	Construction	4,657	33.99	14	0.78	16.605	3.40
	Commerce, hotels and restaurants	2,758	20.13	200	11.15	4.49	0.92
	Transport, storage, and communication	1,019	7.44	56	3.12	2.16	0.44
	Services	1,409	10.28	1,076	59.98	24.85	5.09
	$(N = 5{,}327\,, a = 0.11577)$					D= 50.62	I_p=10.36
West Bank	Agriculture	913	8.78	110	7.11	0.835	0.19
	Manufacturing	2,065	19.87	328	21.19	0.66	0.15
	Construction	3,881	37.34	12	0.78	18.28	4.13
	Commerce, hotels and restaurants	2,029	19.52	190	12.27	3.625	0.82
	Transport, storage, and communication	509	4.9	54	3.49	0.705	0.16
	Services	996	9.58	854	55.17	22.795	5.14
	$(N = 3{,}830\,, a = 0.12963)$					D= 46.9	I_p=10.58
Gaza Strip	Agriculture	505	15.26	2	0.81	7.225	0.53
	Manufacturing	376	11.36	8	3.25	4.055	0.35
	Construction	776	23.45	2	0.81	11.32	0.83
	Commerce, hotels and restaurants	729	22.03	10	4.07	8.98	0.72
	Transport, storage, and communication	510	15.41	2	0.81	7.3	0.54
	Services	413	12.48	222	90.24	38.88	1.17
	Agriculture	505	15.26	2	0.81	7.225	0.53
	$(N = 1{,}497\,, a = 0.06919)$					D= 77.76	I_p=4.14

Table 4: Distribution of occupations by type of gender dominance

Female-Dominated	Gender-Integrated	Male-Dominated
Teaching professionals	Health associate professionals	Chief executive, senior officials and legislators
Personal care workers	Business and administration associate professionals	Administrative and commercial managers
	Gender and keyboard clerks	Production and specialized services managers
	Handicraft and printing workers.	
	Subsistence farmers, fishers, hunters and gathers	Hospitality, retail and other services
		Science and engineering professionals
		Health professionals
		Business and administration professionals
		Information and communication technology professionals
		Legal, social and cultural professionals
		Science and engineering associate professionals
		Legal, social, cultural and related associate professionals
		Information and communication technicians
		Customer services clerks
		Numerical and material recording clerks
		Other clerical support workers
		Personal service workers.
		Sales workers
		Protective services workers.
		Market-oriented skilled agricultural workers
		Market-oriented skilled forestry, fishery and hunting workers
		Building and related trades workers, excluding electricians
		Metal, machinery and related trades workers
		Electrical and electronic trades workers
		Food processing, wood workers, garment and other craft and related trades workers.
		Stationary plant and machine operators
		Assemblers
		Drivers and mobile plant operators
		Cleaners and helpers
		Agricultural, forestry and fishery labourers
		Labourers in mining, construction, manufacturing and transport
		Food preparation assistants
		Street and related sales and services workers
		Refuse workers and other elementary workers

Table 5: Maximum Likelihood estimation of Heckit Model of wage equation in the West Bank and Gaza Strip by sector

Consumption equation

	West Bank				Gaza Strip			
	Private Sector		Public Sector		Private Sector		Public Sector	
	Coeff.	Std. Err.	Coef.	Std. Err.	Coeff.	Std. Err.	Coeff. Ψ	Std. Err.
Constant	5.334**	0.280	3.185**	0.540	2.696**	0.624	2.594*	1.304
Education	-0.010	0.016	0.095**	0.018	0.055*	0.030	0.138**	0.035
Tenure	0.001**	0.000	0.001**	0.000	0.001	0.001	0.002**	0.000
Age	-0.016	0.011	0.029	0.018	0.004	0.027	-0.025	0.080
age2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Contract	0.201**	0.056	-0.110	0.340	0.843**	0.136	0.373	0.340
Married	0.269**	0.055	0.073	0.071	0.128	0.124	0.174*	0.103
Other social Status	-0.279*	0.160	-0.112	0.161	-0.310	0.346	(Omitted)	(Omitted)
Refugee	-0.147**	0.039	-0.054	0.054	-0.063	0.095	-0.035**	0.052
Occupation	-0.011	0.012	-0.051**	0.018	-0.023	0.022	-0.064	0.014
Manufacturing	-0.043	0.065	(Omitted)	(Omitted)	0.123	0.142	(Omitted)	(Omitted)
Construction	0.574**	0.063	0.578	0.648	0.530**	0.149	(Omitted)	(Omitted)
Commerce, hotels and restaurants	-0.005	0.071	(Omitted)	(Omitted)	0.113	0.128	0.498*	0.266
Transport, storage, and communication	0.069	0.111	0.117	0.241	0.109	0.134	-0.471**	0.154
Services	-0.249**	0.083	(Omitted)	(Omitted)	-0.077	0.139	(Omitted)	(Omitted)
Union	-0.264**	0.059	-0.044	0.048	-0.013	0.087	-0.018	0.038
Size	0.066**	0.021	0.113**	0.055	0.068	0.047	0.184**	0.050
Hours	0.000	0.002	0.002	0.001	0.003*	0.002	0.003	0.003

Participation equation

	West Bank				Gaza Strip			
	Private Sector		Public Sector		Private Sector		Public Sector	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Const	-0.921**	0.437	2.182	1.752	-0.114	0.773	7.211**	1.473
Education	0.171**	0.035	-0.035	0.069	0.022	0.055	0.123**	0.034
Age	0.118**	0.021	-0.009	0.079	0.081*	0.044	-0.375**	0.066
age2	-0.001	0.000	0.000	0.001	-0.001*	0.001	0.004**	0.001
Married	0.075	0.233	0.264	0.750	0.166	0.268	-0.050	0.362
Other social Status	-0.343	0.352	(Omitted)	(Omitted)	(Omitted)	(Omitted)	(Omitted)	(Omitted)
Spouse	-2.300**	0.152	-0.871**	0.234	-1.199**	0.303	0.210	0.159
Son/Daughter	-0.747**	0.251	-0.078	0.761	-0.508*	0.308	0.165	0.311
Other types of relation to the head of family	0.121	0.092	0.636	0.275	0.417*	0.147	(Omitted)	(Omitted)
Refugee	0.171**	0.035	-0.035**	0.069	0.022	0.055	-0.070	0.117

*Significant at 10%, ** Significant at 5%.
Ψ These results are not reported by the type of industry because employees in the public sector in the Gaza Strip are concentrated in the services sector.

Chapter 2

Diffusion of Technology and Human Capital: A Case study of Palestine

Abstract

This paper explores the factors that affect the decision of Palestinian firms to use Information and Communications Technology (ICT) across economic sectors. Using a variety of econometric techniques, the paper highlights the role of skilled workers in the intensity of ICT usage. ICT usage is modelled as two independent decisions, the decision to own a computer, and the intensity of utilization. The results show that firm size, geographical location, computer system effectiveness, technical compatibility and belonging to the service sector influence the decision to use ICT.

Key words: human capital, technology diffusion, computer use, double-hurdle model.

2.1 Introduction

Recent decades have seen a dramatic decline in computer prices, advances in information technology, great expansion of computer application software and growing investment in Information and Communications Technology (ICT). Advancement in technological efficiency is recognized to play a critical role in long term development. This has led many authors to study the factors underlying the expansion of computer use, and the extent to which computers enhance the competitiveness of firms by producing better quality products at a lower cost and in a shorter time.

Remarkable discrepancies in computer and ICT usage are observed among private Palestinian firms. While some are well-equipped with computers and have kept abreast of new technology, others still lag behind (Palestinian Central Bureau of Statistics, 2012) and their existence is threatened in markets that tend to be more exposed to giant multinational companies with limited barriers against world flows of goods and services.

Since Israeli authorities control the borders of Palestine and oblige Palestinians to import from or through Israel, the Palestinian economy relies to a large extent on Israeli

policies and procedures. Palestinian firms therefore face severe competition from Israeli knowledge-intensive products. The wide gap in technology usage and efficiency between Palestine and Israel (and other developed countries) calls for closer investigation of the technology adoption determinants in Palestinian firms. Understanding the actual channels of technology diffusion in a context of expanding globalization is essential for policy makers (Zhu and Jeon, 2007).

Here computers are used as a proxy of technology diffusion because they are a case of embodied technology. Technology cannot be adopted without being physically embodied in computers, and it is hard to measure technologies that are disembodied.

Like other developing countries, Palestine does not actually produce computers, and the process of adopting computers across Palestinian firms and households takes place through imports. This justifies using imported computers and their components to proxy developments in computer adoption.

In the period 2006 to 2016, the Palestinian Central Bureau of Statistics reported a 71% increase in imported assembled computers and key components, such as central processing units, memory chips, storage devices and peripherals. This raised the value of imported computers and their key components per worker from USD 27.2 in 2006 to USD 30.3 in 2016. This increase in the value of imported ICT components per worker reflects general awareness of the need to adopt and use technology to leverage production efficiency and sustain economic development. However, this improvement in imports of ICT components is still modest compared to the intensive usage of ICT in Israel.

This paper provides new information on the use of computers in the Palestinian business sector by examining the determinants of decisions to own computers and how intensively to use them.

The literature has paid specific attention to the stock of human capital as a factor that affects ownership decisions and level of usage. Educated people make good innovators, since education speeds up the process of technological diffusion (Nelson, and Phelps 1966). When new products or processes are introduced, more must be learnt about the technology and there is a higher premium on the skills of educated labour (Welch (1975)).

The Palestinian Ministry of Higher Education reported a remarkable increase in the number of ICT students enrolled in universities. This number increased from 4459 in academic year 2010/2011 to 7792 in 2016/2017, and 1841 new graduates entered the labour market in 2017 (Ministry of Education and Higher Education, 2017). However, the unemployment rate (32.8%) and daily wage rates (USD 30.6) of ICT graduates were close to the average of that year (33.1% and USD 30.9, respectively) (Palestinian Central Bureau of Statistics, 2017), indicating a large mismatch between the demand and supply sides of ICT skills. However, the extent to which those employed graduates changed the behaviour of firms in terms of ICT usage was nevertheless important.

An aim of this paper was to explore the role of these specialized workers in improving the utilization of ICT components in the production of Palestinian firms.

2.2 Theory and hypotheses

Innovation can be seen as new ideas. Rogers defined innovation as any object, idea, technology or practice that is perceived as new by an individual or adopter. It may be tangible innovation like a physical object or new device, or it may be intangible, like a new design or teaching method (Roger, 1995). In Roger's view, the idea need not be objectively new: it is enough to be perceived as new by the adopter. This paper confines attention to a specific type of innovation, namely those based on computers.

Before exploring the literature on innovation, one needs to differentiate between the concepts of adoption and diffusion. Adoption theories consider the individual and his choices to accept or reject a specific innovation, whereas diffusion theories describe how specific innovations spread through the relevant population over time. In other words, diffusion occurs through adoption decisions made at the individual level and describes how these individual decisions spread: adoption refers to individual decisions, whereas diffusion describes collective adoption processes over time.

Technology adoption is a very mature topic in the literature, and research in this area has resulted in theoretical models geared to identifying factors that speed up the process of technology diffusion among people and organizations. Choosing between these theoretical models is challenging. Here we discuss the most salient and prominent models and choose the constructs that best fit the organizational features of Palestinian firms.

Special attention is paid to four models of technology adoption and diffusion. The first is Rogers's theory of innovation diffusion, which lays the foundation for other adoption theories. The second is the Concerns-Based Adoption Model (CBAM) which has been used to understand the stages of change in teachers' behaviour in response to changes in curriculum. CBAM discusses the stages of concern that teachers express due to changes in teaching materials and strategies. CBAM applies to anyone experiencing change, e.g. policy makers, parents and students. The third and fourth are the Technology Acceptance Model (TAM) and the Unified Technology Adoption and Use Theory (UTAUT). Selected constructs from other models are also considered.

"Diffusion of Innovations" (1962) by Rogers is considered the most influential book on how innovation penetrates specific populations. His Innovation Diffusion Theory (IDT) is a key for understanding the factors that influence individual decisions to accept or reject a specific innovation. As noted, the IDT distinguishes between adoption and diffusion. Adoption proceeds in six stages (Rogers, 1995) from knowledge, persuasion and decision to adopt or to reject, to implementation, confirmation and finally adoption.

The knowledge stage is the starting point for the innovation-decision process. Knowledge is spread via television, magazines, websites and peers. Once persons move beyond simple awareness of a technology, they start seeking and gathering information about its features and cost (persuasion stage). At this point they are considered "potential users" of the technology.

Once the information is gathered, potential users start weighing the advantages, disadvantages, costs, benefits and trade-offs (Cost-Benefit analysis) before arriving at the decision stage. If the benefits exceed the costs, they begin to incorporate the technology into daily life; otherwise, the technology is rejected.

The implementation stage features bringing the innovation into regular use. This stage can be slow and time-consuming, and is when potential users start to evaluate whether the technology meets their expectations and to consider usability and usefulness as evaluation criteria.

If the technology meets their expectations, the process of integrating it is complete. At the confirmation stage, they use the technology to its fullest potential. Otherwise, they reject the technology, which is called delayed rejection.

These six steps describe a model by which individuals decide whether or not to adopt a specific technology, and the next four components determine the extent to which this adopted technology spreads through the population. These components are:

1. The technology itself: its relative advantages, compatibility and complexity.
2. Communication channels that facilitate the passing of information from one individual to another.
3. Features of the social system like the work environment, the organization of groups, social norms and organizational structure influence the speed of technology spread.
4. Time. Rogers (1995) argues that technology diffusion has a time dimension and that early adopters of technology, *inter alia*, hold leadership in the social system, have higher socioeconomic status, and are more likely to be literate and able to tackle uncertainty due to change. The role and attitude of those early adopters is important in the process of technology diffusion and their subjective evaluation about the technology affects the adoption decision of other members of the social system. Adoption of technology by early adopters decreases uncertainty about the innovation and facilitates the process of diffusion.

Although Rogers's theory of innovation provided a foundation for other theories on the determinants of technology adoption and diffusion, it is descriptive rather than prescriptive, and it illustrates why adoption occurs, without tackling the factors that may facilitate it. CBAM goes further, addressing the challenges of adopting new technology by examining the concerns of adoptees and how these concerns influence the integration of innovations.

CBAM was developed by Hall in 1979, and has been broadly adopted in the field of education to examine the affective and cognitive concerns of teachers after changes in educational settings, as well as their role in facilitating change by addressing and easing all these concerns (Hall, 1979, Christou et al, 2004). Teachers' efforts to integrate technology into their curricular practices are expected to improve the performance of both teachers and students (Davies and West, 2014). As a response to the increasing pressures of educational policies that call for accountability, teachers have been encouraged to use technology in the classroom (Larson, 2010). Since the results fell short of expectations, Blackwell *et al.* (2013) and Hew and Brush (2017) discussed the factors that damp adoption of technology and shed the light on teachers' concerns and resistance to adopting new technology that would change current curricular practices. An example of the use of CBAM in educational settings is K-12,[5] where computers and the internet were used in the classroom as part of the federal government's initiative to bring technologies into the education program in the early 1990s (Brenner and Brill, 2016).

CBAM is based on three components: stage of concern (SoC), levels of use (LoU) and innovation configuration (IC). The first describes the attitudes and concerns of teachers, mainly in light of the characteristics of individuals. In the SoC, teachers start by raising their personal concerns and when these concerns are met, they raise their students' issues of implementation. The second and third stages focus on the characteristics of the innovation and describe the changes in teachers' behaviours when implementing new innovation.

Although CBAM addresses the concerns of teachers, it pays little attention to students, who are part of the education system and are also affected by the change. CBAM considers teachers as the end users of technology and ignores the role of students. Yet focusing on students is critical, especially for spreading student-centred teaching. Furthermore, CBAM does not consider positive attitudes towards the integration of innovations. Because it focuses on teachers' concerns without considering positive attitudes, this model ends up viewing the teacher as resisting technological change (Straub, 2009).

The TAM and UTAUT models have often been used to examine the determinants of computer acceptance and usage in a given job. These two models differentiate between attitudes and action. They maintain that individual behaviour is a result of the person's attitudes, and the latter are based on perceptions. In particular, TAM argues that the degree to which individuals believe that adopting technology will be easy plays a significant role in their decision to accept and use technology.

Venkatesh and other researchers tested the explanatory power of eight theoretical models addressing individual adoption and use of computers, including the three just

[5] **K–12** is an American expression that refers to the entirety of primary and secondary education. It is an abbreviation for kindergarten (K) for 5–6 year olds through to twelfth grade (12) for 17–18 year-olds. It indicates the range of years of publicly supported primary and secondary education in the United States.

described, and found that these models explained 17% to 53% of the variance of the use of technology (Venkatesh et al. 2003). UTAUT explained 69% of the variance of the use of technology and outperformed the eight models. However since the UTAUT model was published fairly recently (2003), further research is needed to confirm its performance.

2.3 Determinants of computer adoption and ICT usage in Palestinian organizations

Based on the above summary of the most commonly used theoretical models, the present paper selects the constructs most likely to fit the organizational structure of Palestinian firms. Individuals and organizations share several determinants of computer adoption and usage. However, organizations have specific determinants that do not apply to individuals.

Part of these determinants are related to the technology itself, including relative advantages, compatibility and complexity. However, the adopter's characteristics also play a role. For example, firms differ in their willingness and ability to adopt new technology based on their size, the stock of human capital hired, market structure and the extent to which the technology is perceived as useful. Although complexity is expected to have a negative effect on the decision to adopt new technology, employment of skilled workers who know how to handle this complexity offsets this effect. Based on existing theories and the corresponding empirical evidence, we briefly examine the role of the main determinants found in the literature and formulate four hypotheses to test in the Palestinian case.

2.3.1 Firm size

Previous studies examined the effect of firm size on adoption of computers, and many found it to be relevant. The rationale behind this is that large firms share a high degree of organizational complexity and need to keep extensive and detailed records. They also find it more profitable to adopt new technology, as they have better access to credit and are more able to spread risks and exploit economies of scale (Davies, 1979; David, 1975). In contrast, small firms may face tighter financial constraints which prevent them from investing or recruiting the necessary expertise to develop and operate computerized information systems.

Hypothesis 1: Firm size is positively related to the levels of computer adoption and of ICT usage.

2.3.2 Human capital

The Model of PC Utilization (MPCU) views the complexity of technology as the core factor affecting the level of technology usage. Thompson (1991) defined complexity as

the degree to which an innovation is perceived as relatively difficult to understand and use. Complexity of new technology can be offset and handled by accumulating human capital.

Human capital accumulation is seen to have a direct effect on innovation diffusion, as no technical change can be considered independent of human interaction. Qualified workers are better able to deal with the latest techniques of production and have a comparative advantage in acquiring and implementing new technology (Kiley 1999). Goldin and Katz (1996) confirmed the existence of significant complementarities between investment in, or adoption of, new technology and human capital accumulation/investment in education.

Human capital accumulation raises self-efficacy (appraisal of one's ability to use a technology to accomplish a particular job or task). Self-efficacy in a particular computer-based task may in turn influence perceived ease of use (Agarwal et al, 2000).

The fact that investing in skill-biased technology and human capital stock are complements is a potential source of endogeneity bias due to the reverse causality between skilled human capital and investment in ICT. The increasing stock of skilled labour leads new technology to target a more skill-intensive mix of users (Kiley 1999). Hence, firms hire ICT staff in anticipation of having to manage complexity and in order to keep abreast of the latest updates, which becomes a self-fulfilling prophecy.

Hypothesis 2: Computer skills are positively related to level of computer adoption.

Hypothesis 3: Specialization in ICT is positively related to the complexity of the ICT adopted.

2.3.3 Effectiveness of computers

Using new technology is not tantamount to adopting it. At the stage of implementation, users start evaluating a technology and examining the extent to which it meets their expectations. If a technology falls short of expectations, it is abandoned, and *vice versa*. The idea that adoption and use depend crucially on the extent to which workers or employers believe that using a particular system would enhance their job performance (perceived usefulness) is a core construct of the Technology Acceptance Model (TAM) and the Model of PC Utilization (MPCU) (Davis 1989, and Thompson et al, 1991).

Effective computing reduces transaction costs and time. This in turn raises the quality of products and customers. Different measures of computer effectiveness have been proposed. Here we use two measures, namely the firm owner's satisfaction with how much computers have helped reduce transaction time (perceived usefulness), and the "percentage of electronic transactions in relation to total transactions".

Hypothesis 4: The more computers improve firm performance, the higher the ICT usage.

2.3.4 Technical compatibility

Compatibility is a core construct of the IDT model, and it is defined as the degree to which an innovation is perceived as being consistent with existing values, needs, previous experience and any existing supporting technology. Compatibility is seen as a key determinant of adoption of new technology. To this end, this paper adds the variable of compatibility as a regressor in the model.

Hypothesis 4: The more supporting technology, the higher ICT usage.

2.4 Research design and methodology

The Palestinian Central Bureau of Statistics carried out two waves of its Business Survey on Information and Communications Technology in 2008 and 2012, targeting 2540 and 2300 firms, respectively. The sample was weighted to represent 92,028 firms across the West Bank, including East Jerusalem (65,139 firms) and the Gaza Strip (26,889 firms).

The survey provides data on firms' use of computers, the type of applications used (operating, administrative or scientific software), expenditure on maintenance of electronic equipment and expenditure on scientific software. It also provides information on firm characteristics such as size, sector and number of skilled and unskilled employees.

Of the 2300 firms surveyed in 2012, 50.9% did not use computers and 87.4% spent zero dollars on ICT in the year of the survey. While in principle the *Tobit model* could be used to overcome the dilemma caused by censoring the dependent variable at zero, the shortcoming of this model is its inability to address the sources of these zeros. To overcome this limit, Cragg (1971) introduced the *"double-hurdle"* model, building on the assumption that two hurdles must be overcome in order to observe positive values in the data. With specific reference to our model, the first hurdle is the participation or ownership decision, which reflects the desire or willingness to own a computer, and the second hurdle is consumption or the intensity of use of the computer(s). While the first hurdle uses the whole sample, the second uses the subsample of those who own a computer.

2.4.1 Measurement of computer adoption and level of usage

As repeatedly stated, estimating the factors affecting a firm's decision to own computers and the level of ICT usage is the core objective of this paper. Some research has measured the intensity of use in terms of the time spent on computers or internet, or has used the number of computers owned as a proxy. But these indicators do not reflect the extent to which computers are used for ICT purposes. To overcome this

deficiency, this paper measures the usage intensity of ICT in terms of total expenditure on scientific software (ICTEXP), including expenditure on training staff in ICT and expenditure needed to carry out ICT-related research and development. ICTEXP is used as the dependent variable for the second hurdle of the double-hurdle model, while the binary variable of ownership decision (COWN) is the dependent variable of the first hurdle.

Reverse causality between expenditure on ICT and ICT-specialized staff (TNICT) raises the problem of endogeneity bias. The issue is addressed here by resorting to a 2SLS simultaneous equation system. The variables serving as instruments for TNICT are: types of software application (TYPE), total number of scientific applications (TNSPG) and the percentage of the annual budget devoted to research and development (PBRD). The overidentification test in section 2.5.2 (Model selection) supports the validity and coherence of the whole set of instruments and indicates that these three variables may be considered good instrumental variables.

2.4.2 Measurement of covariates for computer adoption and level of computer usage

A. Firm size

Employment, sales, value added and assets are the four indicators most frequently used in the literature to measure the size of firms. Changes in market prices may clearly distort the measurement of volumes that the last three indicators aim to capture. While this can be avoided by fixing the prices at a given level/year, there are other shortcomings. The volume of sales is the most popular measure of firm size due to its ease of calculation. The value-added indicator is a superior measure, but it is also the most difficult to calculate. Regarding the value of assets, it differs from firm to firm depending on the calculation method, making comparisons between firms problematic.

This paper uses the number of employees to gauge firm size. The number of employees is not without shortcomings, e.g. the expertise and efficiency of employees differ across firms, but these shortcoming have been considered less serious than those of other indicators (Clark, 1994).

Size was classified in three levels: small, medium and large. This categorization is based on the classification used by the Palestinian Central Bureau of Statistics, according to which small firms employ less than 5 workers, medium firms employ 5-10 workers, and large firms employ more than 10 workers.

B- Human capital

Most of the literature uses years of education to measure learned skills, but this indicator does not reflect the quality of education. Here instead we use the level of specialization to measure the quality of human capital employed. Employees were

divided into two categories. The first includes employees who know how to use computers but are not specialized in ICT (COMEMP). The second category only includes staff specialized in ICT (TNICT), like computer engineers, electronic engineers, telecommunications engineers, programmers, designers and systems analysts.

C- Computer effectiveness

Two main approaches are used to evaluate the effectiveness of new technology: user-perceived effectiveness, which relies on measures of effectiveness as perceived by users of the system, and the "behavioural approach", also known as "usage approach". The first relies on indicators like user satisfaction and perceived system quality, while the latter uses indicators like number of reports generated, number of changes made to the file and connect time (Srinivasan, 1985).

User satisfaction is measured by scoring the attitude of the firm owner regarding the extent to which computers facilitated transactions. This indicator has been criticized because it depends on personal perceptions which may result in bias. Measurement of system usage is clearly more objective as it does not depend on personal perception, but different measures apply. Lucas (1974) defined system usage as the utilization level of the computer system in specific functions, while Vanlommel and De Brabander (1975) constructed an index based on the number of applications, such as job orders or sales statistics, to gauge system usage.

We used both approaches: objective use is measured by the proxy indicator "Percentage of electronic transactions with respect to total transactions" (ELECT). Concerning user-perceived effectiveness of the system, the survey offers a variable capturing the extent to which the computer system is seen to help reduce transaction times (RTIME).

D. Compatibility

Technical compatibility is gauged here by the existence of Intranet, Extranet, Local Area Networks (LAN), Wide Area Networks (WAN), Virtual Private Networks (VPN) and Wireless Networks. All such connection tools provide infrastructure for using ICT.

2.4.3 Status of computer adoption in Palestinian firms

In the 5-year period 2008–2012, Palestinian firms reported a dramatic increase in the use of computers: from 22.8% in 2008 to 49.1% in 2012. The order of magnitude was not too dissimilar on the West Bank and in the Gaza strip. On the West Bank, computer-adopting firms increased from 25.5% to 51.7%, while for Gaza-based firms the share of adopters jumped from 16.1% to 42.8% in the same period. However, most computer-adopting firms (66.5%) owned just one computer, 12.9% owned two computers, while 7.2% and 5.1% of firms owned three and four computers, respectively. We see striking differences when firms are classified by size and economic sector: 93% of large firms

owned computers, followed by medium firms (68.8%), while only 40.4% of small firms owned computers.

Firms in the services sector ranked highest in terms of computer adoption at 97.4%, followed by firms in the construction sector at 91.5% and only 29.4% for manufacturing firms (Table 2.1).

Although this increase in computer adoption took place recently, the level of adoption of computers is still considered to be low, since 46,840 firms (50.9%) in Palestinian territory do not use computers. Among computer-adopting firms, internet is used for different purposes. Sending and receiving emails constituted 51.1% of usage, followed by obtaining information about goods and services (21.7%). The remaining 12.6% was accounted for by information search. This high percentage of internet usage for simple tasks vindicates the choice of not using the indicator "time spent" as a proxy for the level of ICT usage and resorting instead to the indicators illustrated in the next section.

Table 2.1: Characteristics of computer-adopting and non-adopting firms

	All firms (% distribution)		% Firms that had adopted computers		% Firms that had not adopted computers	
	2008	2012	2008	2012	2008	2012
Region						
West Bank	70.9	70.8	25.5	51.7	74.5	48.3
Gaza Strip	29.1	29.2	16.1	42.8	83.9	57.2
Size (%)						
Small	50.9	75.3*	(26.4)**	(40.4)	(73.6)	(59.6)
Medium	17.4	17.7	(53.0)	(68.8)	(47.0)	(31.2)
Large	31.8	7.1	(84.2)	(93.0)	(15.8)	(7.0)
Sector (%)						
Manufacturing	15.9	14.4	(21.9)	(29.4)	(78.1)	(70.6)
Construction	0.6	0.40	(57.7)	(91.5)	(42.3)	(8.5)
Trade	58.7	58.0	(17.3)	(51.9)	(82.3)	(48.1)
Transport and Communications	22.9	25.1	(32.6)	(51.8)	(67.4)	(48.2)
Financial	1.09	1.27	(58.8)	(51.2)	(41.2)	(48.8)
Services	0.79	0.75	(87.5)	(97.4)	(12.8)	(2.6)

*Column distribution. The figures of the three sizes add up to 100%
** Raw distribution. The figures of the same size add up to 100%.

2.4.3.1 Level of ICT usage

In Palestine, the level of ICT usage differs with geographical location, economic sector, size and the availability of personnel specialized in ICT (purchasing software applications, training staff in ICT services, ICT research and development). Most firms (87.4%) in the sample reported zero expenditure on ICT technology in the year of the survey. Of these, 39.8% did not have any computers, against 60.2% which had at least one.[6] The Gaza-based firms spent an average of USD 243 on ICT compared to their West Bank counterparts who spent USD 1542. Big firms used ICT more intensively (USD

[6] This hints in advance that the model that explains the zero value of expenditures on ICT solely on the basis of non ownership of computers is inappropriate.

7220) than medium (USD 346) and small firms (USD 193). Working in the financial intermediation sector made firms more likely to be ICT users than firms in other sectors. A remarkable difference in ICT usage was observed between firms with staff specialized in ICT (USD 6092) and firms without such personnel (USD 171).

2.4.3.2 Complexity of using computers

The complexity of computer usage can be gauged by the type of software programs used. About eighty percent (80.8%) of computer-adopting firms operating on the West Bank did not use engineering programs, and the same was true of those in the Gaza Strip (82.2%). Engineering programs were only used by 17% of industrial firms, without any direct relation to their size. The share reached 19.5% in large firms compared to 11.3% and 10.2% in medium and small firms, respectively.

Financial programs were the most widespread across all firms (60% of all firms). This percentage rose to 69.5% for firms working in the industrial sector. With respect to size, 79.8% of large firms used financial programs, and this percentage fell to 53.3% among medium sized firms and to 34.7% among small firms.

In order to better reflect the level of complexity of computer use, professional applications/software were assigned to three different classes in this order: operating software that included Microsoft and Open Source products; administrative software that included financial and statistical programs; scientific software that included engineering, GIS and graphic design programs.

No discrepancies in terms of operating systems were found between firms, whereas remarkable differences in more complicated software were seen between large, medium and small firms. Large firms constituted 67.7% of users of administrative software and 60% of users of scientific software (Table 2.2).

Intensive use of administrative software was evident among the most active users in the manufacturing sector (70.8%), followed by those in the trade sector. Differences were more obvious between the construction and service sectors, where 65% and only 13.2% of firms used such software, respectively.

Table 2.2: Characteristics of computer-using firms by type of software

	Firms using operating software*		Firms using administrative software**		Firms using scientific software***	
Size (%)						
Small	26.4*	(97.9)**	14.3	(33.4)	21.1	(25.9)
Medium	18.7	(97.9)	17.9	(59.2)	18.9	(32.8)
Large	54.9	(98.7)	67.7	(76.9)	60.0	(35.7)
Sector (%)						
Manufacturing	31.6	(98)	36.3	(70.8)	31.4	(32.3)
Construction	8.1	100	8.4	(65)	16.0	(65)
Trade	14.9	(97.9)	16.4	(67.9)	11.8	(25.7)
Transport and Communications	24.2	(97.7)	21.0	(53.6)	28.7	(38.4)
Financial	8.9	(99.1)	6.6	(54.9)	7.1	(26.1)
Services	12.3	(99.3)	11.4	(57.9)	4.9	(13.2)

*Column distribution. The figures of the three firm sizes add up to 100%
** Raw distribution. The figures of the same sized firms add up to 100%.

2.4.4 Model specification

To address the problem generated by too many zeros among dependent variables for computer ownership or level of ICT usage, *Tobit*, *Heckit* and *double-hurdle* models were used.

While choosing the regressors for the Tobit model is straightforward, researchers have selected the regressors for the Heckit and double-hurdle models in different ways. The latter two models have two tiers (stages), the first representing the selection or participation stage (the decision to own a computer in our context), the second the consumption or level of usage (level of ICT usage). Choosing different sets of regressors in each stage adds complexity to the model. The regressors selected here are drawn from theoretical models and capture organizational structure. The firm-level variables, size, skill of staff, economic sector and geographical location (West Bank versus Gaza Strip) were chosen in the selection equations of the Heckit and the double-hurdle models, whereas the second stage equation had the same regressors as the first stage, plus the effectiveness and compatibility variables.

Both the decision to participate and the decision to consume come from unobserved utility functions that represent the propensity to own a computer and the utility gained from usage. The decisions to participate and consume are modelled by the respective equations:[7]

(1) $y_{1i}^{*} = X_{1i}'\beta + u$

(2) $y_{2i}^{*} = X_{2i}'\gamma + \varepsilon$

[7] For further details, see appendix A.

where

(3) $X'_{1i}\beta = \beta_0 + \beta_1 SIZE_i + \beta_2 TNICT_i + \beta_3 COMEMP_i + \beta_4 WB_i + \beta_5 Isic_i$

(4) $X'_{2i}\gamma = \gamma_0 + \gamma_1 SIZE_i + \gamma_2 TNICT_i + \gamma_3 COMEMP_i + \gamma_4 WB_i + \gamma_5 RTIME_i + \gamma_6 ELECT_i + \gamma_7 Isic_i + \gamma_8 TCOMPA_i$

and y_1^* and y_2^* are latent variables that reflect the utility of owning a computer and of use of ICT;

$SIZE$ is firm size (1 small, 2 medium, 3 large);

$TNICT$ is the total number of employees specialized in ICT (designers and systems analysts, programmers, computer engineers, electronic engineers, telecommunications engineers);

$COMPEMP$ indicates the number of employees who use computers but are not specialized in ICT;

$ELECT$ indicates the percentage of electronic transactions out of total transactions;

$RTIME$ indicates whether the firm owner sees that the computer helped reduce transaction times (1 yes, 0 no);

WB indicates whether the firm is on the West Bank or in the Gaza Strip (1 West Bank, 0 Gaza Strip);

Isic* indicates sector of work (1 manufacturing, 2 construction, 3 trade, 4 transport and communications, 5 financial activities, 6 services);

TCOMPAT_1 indicates whether the firm has Intranet (1 yes, 0 no), TCOMPAT_2 indicates whether the firm has Extranet (1 yes, 0 no), TCOMPAT_3 indicates whether the firm has a Local Area Network (LAN) (1 yes, 0 no), TCOMPAT_4 indicates whether the firm has a Wide Area Network (WAN) (1 yes, 0 no), TCOMPAT_5 indicates whether the firm has a Virtual Private Network (VPN) (1 yes, 0 f no) and TCOMPAT_6 indicates whether the firm has a wireless network (1 yes, 0 no).

The vector β contains the coefficients for the participation equation, while γ is the vector of coefficients for the consumption equation, and the *logit* regression model is used to estimate the probability of owning computers (COWN). In formal terms:

(5) $Pr_i = 1/[1 + \exp(-X'_{1i}\beta)]$

where subscript i is the ith observation, and Pr_i is the probability that the ith observation falls in a certain category of the dependent variable, given the values of covariates.

The type of association between the participation and usage decisions determines the likelihood function to be estimated. If the decisions are made sequentially, the resulting model is called dominance (Amemiya and Powell, 1981). This is the case of the Heckit model. *Heckit* is based on the assumption that the error terms are correlated, and that the participation decision dominates the consumption or level of use decision. Instead if

the two decisions are made simultaneously, the resulting model features potential independence (the correlation between u and v is zero). The double-hurdle model postulates that the decisions (participation and consumption) are made separately, which means that there is room for feedback from the consumption decision to the participation decision (Deaton and Irish, 1984). This room for feedback rules out the idea of complete independence in favour of partial independence, and is in line with Rogers's IDT which states that at the implementation stage, the person starts to evaluate whether the technology meets his expectations. If so, the technology is integrated, otherwise the technology is rejected. Hence, the concept of independence in the following text should be seen as partial rather than complete independence.

The Business Survey on Information and Communications Technology asked interviewees about expenditures on ICT in the year of the survey, while the question on computer ownership asked whether or not the firm had a computer, which means that the ownership decision may have been made in previous years. The data shows that 32.6% of computer-using firms reported spending zero dollars on new computers in the year of the survey, which means that the decision to adopt computers had been made in previous years, and these firms constituted 59.9% of those that reported positive ICT expenditure. This casts doubt on the assumption that usage depends strictly on adoption, and favours the double-hurdle model, which assumes independence.

2.4.5 Estimation methods

Less than ninety percent (87.4%) of the surveyed sample reported zero expenditure on ICT. This brings us to the dependent variable that is censored at zero. A zero value of the dependent variable can be explained in two ways. First, the firm decided not to own a computer (which implies zero expenditure on ICT) as a utility maximizing decision (standard corner solution generated by a constrained budget). Second, the firm owns a computer but reported zero expenditure on ICT. Zero values in the former case are related to the respondent's computer ownership decisions, while the zeros in the latter case arise from use decisions.

To deal with the censored dependent variable, Tobin (1958) formulated the *Tobit* model that allows all observations including those censored at zero to be incorporated, but without accounting for the determinants of these zeros. The Tobit model considers that all zero expenditures on ICT arise from the corner solution which is implausible. The Tobit model also has statistical restrictions because it assumes that the set of factors influencing the probability of owning a computer are the same as those that influence the level of usage. Recent studies have proven the inappropriateness of the Tobit model in cross-sectional analysis and have preferred the double-hurdle model (1987; Jones, 1989; Pudney, 1989; Blaylock and Blisard, 1993).

To overcome the problem of sample section bias, Heckman (1979) proposed a two-step estimation called *Heckit*. This model handles the problem associated with the zero

observations generated by the decision not to participate (not to own computers). The first step of the *Heckit* model is estimating the probability of observing positive outcome, and it is called the participation equation of the model; the second step is estimating the level of participation, which Dow and Norton (2003) called the conditional equation. Sigelman and Zeng (1999) describe the move from the Tobit model to the Heckit model as a move from a restricted model to one of more general applicability. Analysts of political data rarely have specific information about the data-generating process, and this may lead to inappropriate use of the Tobit model when the zeros are not due to a censoring mechanism, which in turn results in poor fit and incorrect inferences. Sigelman and Zeng's advice is therefore to rely on the more general model, i.e. the *Heckit* model. They see the latter model as a generalized version of the *Tobit* model because it tackles zero observations with two decisions and allows a different set of covariates to be used in each decision step.

The first part of the *Heckit* model runs Logit or Probit estimation using the full sample, including the zero observations, and the second uses the censored estimation based on the subsample. The model allows different sets of factors to be used in each estimation. It suffers from the restrictive assumption that there should be no zero observation in the second stage once the first stage is passed. In our case, the model assumes that only non-computer-adopting firms can report zero expenditures on ICT, and it also assumes that computer-adopting firms cannot report zero expenditures on ICT. To overcome this problem, Cragg (1971) suggested the "*double-hurdle"* model which relaxes the restrictive assumption of the *Heckit* model, and in our case, permits computer-adopting firms to report zeros in the second stage of the estimation. This means that the zeros in the first decision (ownership decision) come from the decision not to own computers, while the zeros in the second stage come from the decision not to invest in ICT, irrespective of whether or not the firm has a computer. It also means that the zero in the second stage decision is not solely affected by the participation decision in the first stage.

Although the two models differ in handling the reported zero value of ICT expenditure, both are similar in recognizing that these zeros are determined by two separate decisions, the ownership decision and the level of use decision. Moreover, both allow different sets of covariates to be used in each decision equation, provided this is allowed by the theory being tested.

In line with previous empirical research and the nature of the data used in this paper, which shows that zero-valued expenditure on ICT is not limited to non-computer-adopting firms, we assume that the double-hurdle model is preferable to the Heckit model, and *a fortiori* to the Tobit model. However, the paper estimates all three models and employs statistical tests to confirm our *a priori* expectations regarding which model is most appropriate.

As already noted, a two-stage least-square regression was run to predict the value of the endogenous variable TNICT. Three instrumental variables were used in the first

stage: first, the type of computer applications used (TYPE), which is taught to capture complexity: applications are therefore assigned to three different classes: 1 for operating software, 2 for administrative and 3 for scientific programs. The total number of scientific applications (TNSPG) is the second instrument, with the third measuring the share of the annual budget devoted to research and development (PBRD).

2.5 Estimation results

This section presents the estimation results of the three models: Tobit, Heckit and double-hurdle. We first illustrate the results of the first stage, which is common to two of the models (Heckit and double-hurdle), i.e. a logit regression of the probability of adopting computers. Using the log-likelihood ratio (LR) and the Vuong tests, we then compare the three models based on the second-stage results of the Heckit and double-hurdle and the (one-stage) Tobit results. Since this comparison favours the double-hurdle approach, we finally focus on this model and discuss it in detail.

2.5.1 First-stage results

Table 2.3 reports the results for the logit regression on the probability of adopting computers. All the covariates are significant in predicting adoption, with several goodness of fit measures indicating that the *Logit* model performed well (Table 2.3). The likelihood ratio test indicates overall significance at 0.01 level, and McFadden R^2 is acceptably high at 0.38. Also, the Percentage of Correct Prediction is high both for adopters (81.8%) and non-adopters (82.3%).

The marginal effects from Logit indicate that having one more employee specialized in ICT raises the probability of owning computers by 54.5%, compared to 7.1% for one more employee who only knows how to use computers. Generally, a big West-Bank firm in the service sector with ICT employees has a 25.6% higher probability of owning computers than a similar firm in the manufacturing sector.

Table 2.3: Logit model of computer ownership by firms

Variable	Coefficient	Z-statistic	Marginal Effect[8]
Const.	-3.306**	-17.00	
SIZE	0.670**	7.28	0.1247**
TNICT	2.931**	11.58	0.5453**
COMEMP	0.380**	5.60	0.0707**
WB	0.491**	3.82	0.0948**
Construction	1.859**	8.22	0.2127**
Trade	0.325*	2.10	0.0578*
Transport and Communications	0.503**	3.16	0.0869**
Financial	1.041**	3.76	0.1497**

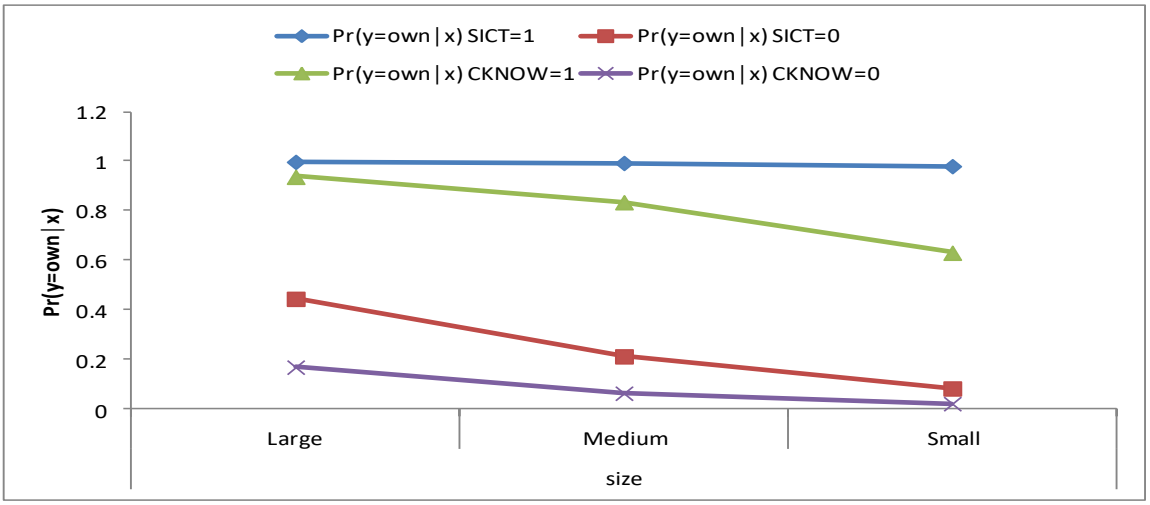
[8] Marginal effect is computed as a marginal change when a regressor changes by an indefinitely small amount or as a discrete change when a regressor changes by a fixed amount. For the Logit model, the marginal effect is computed using this equation: $\frac{\partial E(y|x)}{\partial x} = \beta\Phi(\frac{x\beta}{\sigma})$. The magnitude of the difference in the predicted probability depends on the value of x where the difference is computed.

Variable	Coefficient	Z-statistic	Marginal Effect[8]
Services	2.710**	10.04	0.2556**
McFadden R2	0.375		
Log likelihood	-1001.64		
Log likelihood, restricted	-1603.78		
Model Chi-square	491.38**		
Correct Predictions (%) Total: 81.8% Owners: 81% Non-Owners: 82.3%			

The marginal effect is calculated with mean values of all variables
*Significant at 10%, ** Significant at 5%.

To illustrate graphically the effect of having ICT staff on the probability of owing a computer, the continuous variable TNICT was transformed into the dummy variable SICT (1 the firm has ICT staff, 0 otherwise) and the continuous variable COMEMP was transformed into the dummy variable CKNOW (1 the firm has staff who use computers, 0 otherwise). Figure 2.1 shows that having ICT staff in the firm offsets the effect of firm size. In the absence of ICT specialists, the likelihood of adopting computers decreases with decreasing firm size, even if the firm has workers who are familiar with computers. This is the first indication that the double-hurdle model may be more appropriate, as it does not assume that the decision to own depends on how intensely computers are used. Further evidence is discussed below.

Figure 2.1: Predicted probabilities of computer ownership for different firm sizes



2.5.2 Second stage: model selection

Before marshalling this evidence, we need to go back to the issue of endogeneity. In the analysis of the firm's behaviour and its likelihood of using ICT in its daily operation, one cannot disregard the problem of reverse causality between the demand for ICT staff and the level of ICT usage. This results in the problem of endogeneity bias, which not only gives biased estimates of the coefficients, but also prevents proper identification of the

effects of some important factors, like geographical location and certain technical compatibility variables.

To overcome this problem, we used the simultaneous equation system with two-stage least-square regression. The results for the first stage confirmed the existence of a significant relation between the instrumental variables and ICT staff employed by the firm (Table 2.4).

Table 2.4: First stage estimates for the total number of staff specialized in ICT

Variable	*Coeff.*	*S.E.*	*t-stat*	*p-value*
Const	0.622	1.028	2.29	0.022
SIZE	0.737	1.072	0.69	0.492
COMEMP	-0.002	0.063	-0.04	0.969
RTIME	4.225	2.186	1.93	0.054
Construction	0.395	1.960	0.2	0.840
Trade	-0.367	2.817	-0.13	0.896
Transport and Communications	-0.695	2.453	-0.28	0.777
Financial	-1.231	2.162	-0.57	0.569
Services	3.700	3.011	1.23	0.219
TCOMPAT_1	0.232	6.811	0.03	0.973
TCOMPAT_2	0.147	1.826	0.08	0.936
TCOMPAT_3	1.237	2.670	0.46	0.643
TCOMPAT_4	0.976	3.409	0.29	0.775
TCOMPAT_5	3.288	3.911	0.84	0.401
TCOMPAT_6	0.658	5.245	0.13	0.900
TYPE	1.798	0.793	2.27	0.024
TNSPG	2.247	0.443	5.07	0.000
PBRD	0.137	0.034	4.06	0.000
Durbin (score) chi2(1)	103.984 (p = 0.0000)			
Sargan (score) chi2(2)	2.78408 (p = 0.2486)			
F-test	12.93			

The Durbin test for exogeneity confirms an endogeneity bias problem while the F-test discards the possibility that the instruments are weak. The Sargan test of overidentifying restrictions with a high degree of overidentification supports the validity and the coherence of the whole set of instruments.

Two kinds of test were employed to identify the best model. Firstly, the Tobit model was tested against the Heckit and then against the double-hurdle model using the Likelihood Ratio test. Secondly, the double-hurdle model was tested against the Heckit model using Vuong test.[9] Table 2.5 shows that both the double-hurdle model and the Heckit model are superior the Tobit model. This confirms the existence of two separate

[9] The Vuong test was produced by Guang H. Vuong in 1989. It uses the Kullback-Leibler Information Criterion (KLIC) to measure the closeness of a model to the true generating process. Vuong tests the null hypothesis that competing models are equally close to the true generating process against the alternative hypothesis that one model is closer. It measures the distance between a given distribution and the true distribution. If the distance between a specified model and the true distribution is defined as the minimum of the KLIC, then it can be considered the closest to the true distribution (the best model) among other competing models.

decision-making process in which the firm decides to own a computer and to invest in ICT. It also suggests that zero-valued expenditures in ICT do not always arise from the corner solution.

The results of the Vuong test confirm the superiority of the double-hurdle model over the Heckit model and reject the assumption of first-stage dominance, thus rejecting the claim that the zero value of expenditures on ICT is merely a consequence of not owning a computer. Overall, therefore, these results support the conclusion that the decision to invest in ICT is the outcome of two independent decisions.

Table 2.5: Specification tests for the Tobit, Heckit and double-hurdle model.

Model	Test value[Ψ]	Decision
Standard Tobit vs Heckit model	1056.67* (18)	Reject Tobit model
Standard Tobit vs double-hurdle model	1221.11* (18)	Reject Tobit model
Double-hurdle model vs Heckit model	112.44*	Reject Heckit Model

[Ψ] The column reports the LR test for the first and second row, and the Vuong test for the third row. The values in brackets are degrees of freedom (number of regressors including the intercept).

2.5.3 Second stage: results of the double-hurdle model

Having identified the double-hurdle model as the most appropriate, we now review the results of this model in detail, in particular its instrumental variables (IV) specification. Recall that the LR test[10] came out in favour of the IV estimates, showing that IV improved the fitness of the double-hurdle model compared to non-IV estimates.

Three out of nine covariates affected the decision to own a computer and achieved statistical significance, all with a positive sign albeit with a low marginal effect. Eleven out of seventeen covariates significantly affected the decision to invest in ICT (Table 2.6).

Firm characteristics: In detail, the decision to own a computer does not appear to associate with the size of the firm or with the mere presence of staff familiar with computers, although knowledge of how to use a computer has a positive effect. Furthermore, working in the services or the construction sector raises the probability of owning a computer compared with respect to the manufacturing sector, while the other sectors make no difference.

Compared to owning computers, using them appears to be more strongly affected by the presence of ICT staff who can manage complex new technology, while simple familiarity with computers does not appear to play a clear role even at this stage. Firm size also plays a critical role in the second-stage decision, since belonging to the next size class raises expenditure on ICT by USD 568.3. Since smaller firms have less access to credit, this is hardly surprising. Another possible reason is that small firms tend to have less complex production processes. Finally, working in different sectors does not appear to vary significantly with respect to the second-stage decision, with the clear exception of the service sector where incentives to invest in ICT appear to be stronger.

[10] The log likelihood ratio of non-IV estimates was -3591.66 compared to -3429.19 of IV estimates, and the difference in model fitness was significant.

Location characteristics: Although the West Bank and Gaza Strip are both in Palestinian territory, they are separated geographically and have different legal systems and economic structure. This is reflected in the model's estimates that geographical location hardly plays a role in a firm's decision to own a computer, but may be important for usage. West Bank firms are estimated to spend USD 580.7 more on ICT than their Gaza Strip counterparts. This supports the idea of market-driven use of computers, as firms working in more competitive markets are under greater market pressure to adopt recent technology in order to survive.

Relative advantage: The *a priori* expectation is that firms invest in ICT if feasible and if it pays dividends. Specifically, the owner's perception that computers reduce transaction times should play a positive role in raising computer usage. However, we found that the share of electronic transactions out of total transactions had a large positive impact on ICT usage, but was not statistically significant.

Technical compatibility: Our results suggest that technical compatibility significantly enhanced ICT usage. According to the literature, expenditure on ICT appears to be more feasible and profitable if the supporting technology is already in place.

Table 2. 6: Maximum likelihood IV-estimates versus non-IV estimates of the double-hurdle model

	Non-IV estimates		IV-estimates	
Consumption equation	Marginal Effect.	S.E.	Marginal Effect.	S.E.
Const	-4582.589	2774.603	-348.045**	1859.668
SIZE	636.793*	372.368	568.335**	234.960
TNICT	5.702**	1.062	52.873**	19.141
COMEMP	3.305	5.201	2.801	3.558
RTIME	157.117	148.797	230.827*	138.536
ELECT	1.566	3.292	1.827	3.379
WB	596.140	372.333	580.677**	284.352
Construction	163.239	187.221	147.375	181.895
Trade	-68.674	181.143	-3.035	146.603
Transport and Communications	-33.208	163.024	-24.073	141.594
Financial	403.434**	195.408	178.336	191.657
Services	556.880**	282.360	494.306**	221.606
TCOMPAT_1	891.200	552.530	812.520**	366.018
TCOMPAT_2	1249.205	838.049	1106.222**	535.656
TCOMPAT_3	1543.815	987.486	1383.568**	663.027
TCOMPAT_4	1479.057*	865.563	1362.101**	567.005
TCOMPAT_5	1714.896*	982.026	1237.109**	492.560
TCOMPAT_6	2140.477**	1057.167	1917.701**	656.429
Participation equation				
SIZE	0.465**	0.022	0.0004	0.002
TNICT	0.000	0.003	0.0002	0.000
COMEMP	0.002*	0.001	0.0001*	0.000

WB	0.205**	0.042	0.0034	0.003
Construction	0.692**	0.075	0.0017**	0.004
Trade	0.099*	0.048	0.0004	0.003
Transport and Communications	0.309**	0.045	-0.0004	0.003
Financial	0.481**	0.067	0.0009	0.004
Services	0.848**	0.069	0.0075**	0.004

*Significant at 10%, ** Significant at 5%.

2.6 Concluding summary

The aim of this paper was to identify the factors that determine the intensity of ICT usage across all economic sectors with a focus on the role of human capital. The two main issues raised by an attempt to identify these factors on Palestinian data were the existence of too many zero values in ICT expenditure and endogeneity bias due to reverse causality between investment in ICT and presence of staff specialized in ICT, a determinant expected to play a core role. To overcome these two problems, we used the double-hurdle model which features two parts, the first estimating the determinants of the firm's decision to buy/own computers, the second estimating the determinants of computer usage. A simultaneous equation system using two-stage least-square regression was used to address endogeneity bias.

The results indicate that use of computers follows from two independent decisions, namely to own computers and how intensely to use them for ICT purposes. They also suggest that the factors achieving significance in the estimation were not the same for the two decisions. While firm size did not appear to affect the decision to own computers, it affected the decision to use them for ICT purposes. The same holds for ICT-specialized staff, whose presence did not seem to play a role in the first-stage decision, but positively affected the second-stage decision.

Conversely, mere familiarity with computers affected the first-stage decision but not the second-stage one, according to our results. Being in the construction or service sectors appeared to raise the probability of adopting computers, whereas being in the service sector positively influenced the level of usage. Finally, geographical location did not play a significant role in the first-stage decision, unlike in the second stage. Regarding the *relative advantage* of new technology, our estimate of the impact of the owner's perception of the benefit of using computers to reduce transaction times was large but not statistically significant, a finding that warrants further investigation. Our results regarding technical compatibility were more clear cut: provided the new technology was technically compatible with the existing technology, it was used more intensively.

Appendix

Table 1: Maximum likelihood IV-estimates versus non-IV estimates of Tobit model

	Non-IV estimates		IV-estimates	
	Coeff.	S.E.	Coef.	S.E.
Const	-34.324**	16.920	-14.982	17.748
SIZE	19.542**	3.558	11.726**	5.000
TNICT	4.345**	0.954	8.887**	2.567
COMEMP	0.259	0.801	0.028	0.739
RTIME	11.615	12.725	20.163	15.226
ELECT	0.107	0.362	0.134	0.370
WB	25.052**	6.934	20.551**	7.241
Construction	18.018**	8.948	13.030	9.404
Trade	-0.618	7.936	-1.590	7.903
Transport and Communications	-2.954	9.039	-5.602	9.226
Financial	34.075**	13.068	-5.546	21.325
Services	69.675**	19.149	56.798**	19.275
TCOMPAT_1	14.984**	4.295	9.702**	4.967
TCOMPAT_2	31.501**	12.704	25.911**	11.285
TCOMPAT_3	66.637**	26.996	54.925**	27.810
TCOMPAT_4	86.136**	22.886	82.517**	25.412
TCOMPAT_5	181.949**	77.454	157.618**	60.452
TCOMPAT_6	461.931**	122.619	543.949**	164.638

*Significant at 10%, ** Significant at 5%.

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Chapter 3

Have the International and Local Aid Programmes Achieved their Goals in Palestine?

Abstract

Donors and international organizations are committed to reducing hunger across the world, and to devoting funds and expertise to this goal. One of the Millennium Development Goals (MDGs) and Sustainable Development Goals 2015-2030 (SDGs) that developed countries are committed to achieving is to halve the proportion of people suffering from hunger worldwide. This study considers Palestine as a developing country and seeks to evaluate whether direct international aid (cash and in-kind) to Palestinian households is in fact achieving food security. The Average Treatment Effect on the Treated in terms of food security was estimated for multi-valued treatment, (international aid and local aid by the Palestinian Authority). The results indicate that aid administered directly by International Organizations and aid administered by the Palestinian Authority boosted food security of Palestinian households across the West Bank and Gaza Strip. However, international organizations appear to have a comparative advantage in providing in-kind aid. The study also recommends widening the base of beneficiaries of cash and in-kind aid programs, as more than half the households can be considered food insecure.

Keywords: generalized propensity score matching, aid efficiency, food security, multi-valued treatments.

3.1 Introduction

Palestine, like other developing countries facing capital resource scarcity, very much relies on international aid. This aid helps bridge the savings-investment and technology know-how gaps, and contributes to financing the trade deficit with Israel. International aid is meant to foster economic growth of developing countries, reduce poverty and improve living standards.

The literature stresses the role of international aid in fostering economic growth through stimulating investment in physical and human capital, supplementing scarce domestic resources, increasing capacity to import technology and capital goods, raising productivity

of capital and labour resources through technology, facilitating exposure to research ideas, accessing new markets and improving managerial skills (Morrissey, 2001).

Official Development Aid (ODA) flows reflect the continued commitment of developed countries to assisting developing countries to foster development goals, including the Millennium Development Goals 2012-2015 (MDGs) and the Sustainable Development Goals 2015-2030 (SDGs) by providing needed financial and technical resources. In line with a longstanding agreement between UN member states, donor countries are committed to providing USD 326 billion (0.7% of donor country Gross National Income, GNI) as ODA. According to recent estimates of the Development Aid Committee (DAC), net ODA reached USD 135.2 billion in 2014 (41.5% of the aid committed), about the same as in 2013. In recent years, ODA flows have stabilized at USD 135 billion, 0.29% of donor countries' combined GNI. However, bilateral ODA to Least Developed Countries (LDCs) fell by 16% in 2014 to USD 25 billion (United Nations, 2015).

The role of international aid to developing countries hinges on several factors. It may be very beneficial to countries with specific political, bureaucratic and economic structures and less beneficial to others. The outcome depends on geographical conditions, economic policies, the political decisions of the ruling elite, bureaucratic efficiency, the role of institutions, socioeconomic development and technological advancement (Sahoo et al, 2013). These factors differ from one country to another and explain the different roles played by international aid in relation to economic growth.

Since the Palestinian authority (PA) was only established in 1994, it has limited access to Palestinian resources and no control on borders. International aid to Palestine has been deemed indispensable to keep poverty in check and to enhance food security.

The international community has shown high commitment in supporting Palestine to achieve its national economic and social development goals. ODA provided to Palestine increased from USD 703.4 million in 1994 to USD 1,423.5 million and USD 2,569.6 million in 2004 and 2013, respectively.[11] This makes Palestine the tenth highest recipient of international aid. Furthermore, the Palestinian economy has witnessed a dramatic increase in net ODA per capita since establishment of the PA (from USD 199.5 in 1994 to USD 358.7 and USD 626.1 in 2004 and 2013, respectively: World Bank).[12]

In the case of conflict and post-conflict countries like Palestine, part of the aid is inevitably tailored to emergencies and relief rather than being targeted at stimulating economic development. This paper therefore focuses on food security and poverty reduction rather than on economic development as goals against which to assess the effectiveness of aid.

The international community has been faced with many obstacles in its attempts to enhance food security worldwide. The year 2015 marked the end of the period set by the international community to achieve two key goals with respect to food security. The Rome

[11] Data based on 2012 prices.
[12] http://data.worldbank.org/country/west-bank-gaza

declaration adopted at the World Food Summit in 1996 called for a 50% decrease in undernourished people by 2015, while the MDGs also called for a halving of the proportion of people suffering from hunger worldwide by the same date. However, the number of people suffering from hunger had only been reduced by 21.4% in 2015, while the drop in the share of undernourished people was closer to the target (41.6%). Progress was therefore made, although the target was missed in both cases (Palestine Economic Police Research Institute, 2015).

Achieving food security in Palestine is also a challenging goal, exacerbated by the economic and political instability of the country. The fact that Palestinian territory is still occupied by Israel and that the Palestinians do not have sovereignty over all of their territory raises the question of how effective international aid is in achieving the food security MDG. This is the first study to evaluate the impact of international aid in Palestine at micro level: it tests the hypothesis that households receiving direct aid from international organizations are better off in terms of food security, and it does so by multi-valued propensity score matching.

3.2 International Aid to Palestine

In the period 1994-2011, Palestine was the tenth highest receiver of international aid per capita (World Bank, 2015). This aid came in the guise of grants to support the Palestinian Budget or project aid, technical aid, direct in-kind or cash aid and emergency relief.

The Palestinian Ministry of Finance[13] reported a budget deficit of NIS 5.68 billion in 2014,[14] NIS 3.68 billion (81.6%) of which was financed by the international community. This aid was 25.3% of the total expenditure of the Palestinian Authority (NIS 14.56 billion). However, only NIS 726.2 million of this international aid (19.8%) went to finance development projects.

The contribution of international aid to the PA's budget enhanced the latter's capacity to provide direct support to poor families. The Palestinian Authority devoted NIS 272.1 million to social services that mainly target vulnerable families (although no clear figure is available on the specific contribution of international aid to this expenditure). These services include education and health coverage, in addition to direct in-kind and cash aid. The social services within the scope of this paper are administered through the Ministry of Social Affairs (MOSA), which targets poor families across the West Bank and Gaza Strip. MOSA undertakes regular surveys using a set of socio-economic indicators to monitor households eligible for its aid. In 2014, MOSA managed to provide social aid amounting to NIS 5.9 million (Palestinian Ministry of Finance, 2014).

In addition to direct support to the PA's budget, the international community is committed to providing direct in-kind and cash aid to vulnerable Palestinian families.

[13] http://www.pmof.ps/
[14] One USD = NIS 3.893 in December 2014.

The United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) is the key actor providing education, health and protection services to 2,020,847 registered refugees across the West Bank and Gaza Strip (Badil, 2015). UNRWA provides in-kind aid to these refugees to improve their standard of living and reduce poverty rates. Other international organizations, including The *United States Agency for International Development (*USAID), *The United Nations Development Programme* (UNDP) and *the Food and Agriculture Organization* (FAO), provide both types of aid to poor families. For example, the Deprived Families Economic Empowerment (DEEP) project implemented by UNDP provides direct aid to poor Palestinians in close collaboration with MOSA: UNDP uses the database made and hosted by MOSA to contact families in need of aid.

The economic literature has intensively explored the link between international/foreign aid and economic growth, using income-based indicators to measure wellbeing. However, measuring wellbeing with income-based indicators does not address the social dimension of international aid impact. Only a handful of researchers have addressed the impact of international aid on social aspects such as health, education, fertility, sanitation and poverty (Shiraz et al, 2009).

Social indicators have shown noticeable improvement in Palestine since 1994. The infant mortality rate (per 1000 lives birth) fell from 30.4 in 1994 to 22.6 in 2004 and 18.5 in 2014. Life expectancy increased from 69.5 years in 1994 to 70.1 years in 2004 and 71.52 years in 2013 (World Bank, 2014). The share of local Palestinian communities[15] connected to a wastewater network increased from 42.9% in 2004 to 60% in 2015, and that of communities connected to the public water network increased from 89.2% in 2004 to 93.3% in 2015 (Palestinian Central Bureau of Statistics, 2004).[16]

We are not aware of studies documenting a causal link between international aid and these social improvements in Palestine, but given the limited capital resources of the PA, it is plausible to suppose that such a link exists.

In strictly economic terms, however, the improvement is modest and it has not lived up to expectations. GDP per capita (2004 prices) fell from USD 1438.1 in 1994 to USD 1,358.1 in 2004, subsequently increasing to USD 1,734.6 in 2014 (PCPS). Descriptive macro-level evidence therefore indicates that social development may have outperformed economic development in Palestine over the life of the Palestinian Authority (i.e. since 1994). In turn, this raises the question of whether and in what dimensions international aid has improved the living standards of Palestinian households. The present paper exploits household-level data from official socio-economic surveys to explore this question, using a matching approach to compare households who did and did not receive aid.

[15] The Palestinian Central Bureau of Statistics (PCBS) classifies Palestinian communities into three types (urban, rural, and camps).
[16] http://www.pcbs.gov.ps/

3.3 Econometric model

Prototypical econometric models used in policy evaluation assume that an individual or unit is in one of two states, either s/he participates in a given policy treatment (e.g. training) or s/he does not. The causal effect is measured by the difference in the potential outcomes of these two states. This is known as the Rubin-Roy model (Roy 1951; Rubin 1974).

In observational studies, pre-treatment adjustment of variables is needed to estimate the average treatment effect, since units (individuals) are not selected at random for treatment; hence the estimate of the final impact may be biased by a selection effect. In other words, comparison of any pair of treated and un-treated units holds as long as pairs are 'similar' in each and all pre-treatment characteristics that may influence the probability of being selected for treatment. To overcome the computational problem entailed by such comparisons, Rosenbaum and Rubin (1983, 1984) proposed the propensity score, i.e. the probability of being selected for treatment conditional on pre-treatment variables. They suggested that treated and untreated units be compared on the basis of the propensity score instead of the vector of pre-treatment variables. Assuming that only observed pre-treatment characteristics ('variables') matter for selection for treatment, they showed that comparisons based on the propensity score are free from selection bias arising from differences in pre-treatment variables.

However, Rosenbaum and Rubin's definition of propensity score is limited to binary treatments and does not handle treatments that take more than two values. This does not fit our case for various reasons: the questionnaire used in the survey asks households whether they received any type of aid in the preceding six months, and if so, the source of each type of aid (in-kind or cash); two sources of aid are identified, namely international organizations including UNRWA, and the Palestinian Authority via the Ministry of Social Affairs (MOSA), both of which provide aid targeting specific groups of beneficiaries.

International organizations target: i) refugees displaced from their houses in Palestine before the 1976 UN resolution (UNRWA services); ii) people living in area C who necessarily have limited access to resources such as land close to Israeli settlements, and land beyond the separation wall which requires special access permits from the Israeli side; iii) people living in Gaza where there have been four wars since 2008, resulting in destruction of houses and loss of life. These wars were accompanied by siege conditions that restricted the movement of people and goods, increasing the exposure of Gazans to food insecurity. The Palestinian Authority targets all Palestinian households on the West Bank and Gaza Strip meeting certain socio-economic criteria. These allocative differences make the aid programs heterogeneous in terms of selection mechanism and types of beneficiaries. This heterogeneity makes it impossible to merge the two types of provision into one, and focusing exclusively on households that received international aid to the exclusion of beneficiaries of the Palestinian Authority could create selection bias. Here we solve this problem by using a multi-valued rather than a binary treatment to assess the impact of international aid.

Imbens (2000) and Lechner (2000a) extended binary-valued treatment propensity scores to the multi-valued treatment case. The treatment of interest denoted by T can take

integer values between 0 and K, or $\mathcal{T}$={0,1,....,K} and is associated with units i. For each value of treatment, the potential outcome is denoted by $Y_i(t)$.

We consider six treatments: 1) in-kind and 2) cash aid programmes of international organizations, 3) in-kind and 4) cash aid programmes of the Palestinian Authority, 5) in-kind and 6) cash aid programmes of international organizations *and* the Palestinian Authority. Each treatment is associated with two potential outcomes: i) food security and ii) steadfastness as defined below in 3.4.

Before we introduce the concept of propensity score, let us examine the key assumption we maintain throughout the discussion of causal inferences. This is formalized by the concept of unconfoundedness. The strong unconfoundedness condition originally proposed by Rosenbaum and Rubin requires treatment T to be independent of the entire set of potential outcomes:

$$T \perp \{Y(t)\}_{t\in\mathcal{T}} | X$$

where X is the vector of pre-treatment characteristics of individuals.

Imbens (2000) proposed 'weak unconfoundedness' to solve the problem of drawing causal inferences. The latter require independence of the potential outcome $Y(t)$ and the treatment to be local, i.e. at the level of the treatment in question rather than with respect to the whole set of potential outcomes. In our case, let $D(t)$ be the indicator for unit i receiving treatment t:

$$D(t) = \begin{cases} 1, if\ T_i = t \\ 0, otherwise \end{cases}$$

Assignment to treatment T is weakly unconfounded for pre-treatment variables X if

$D(t) \perp Y(t)|X$ for all values of $t \in \mathcal{T}$.

That is, the occurrence of individuals benefiting from a specific aid programme is independent of the potential outcome (food security and steadfastness) conditional on the respective pre-treatment characteristics. Weak unconfoundedness implies that in the subpopulations defined by the pre-treatment variables, one can estimate average potential outcomes by conditioning on treatment status:

$$E[Y(t)|X = x] = E[Y(t)|D(t) = 1, X = x] = E[Y|T = t, X = x]$$

where x are specific values of variables X.

However, in practice it is difficult to estimate average potential outcomes when the dimension of X is large. Thus Rosenbaum and Rubin (1984) proposed the one- dimensional propensity score as a way to circumvent the need to condition on the entire set of pre-treatment variables. The binary treatments proposed by Rosenbaum and Rubin were expanded by Imbens (2000) to the Generalized Propensity Score (GPS) denoted by $r(t, x)$, which is defined as the probability of receiving a particular level of treatment given the pre-treatment variables:

$$r(t, x) = pr(T = t|X = x) = E\{D(t)|X = x\}).$$

The GPS defines a single random variable as a transformation of two random variables T and X.

The GPS is designed to comply with the balancing property, which does not require any form of unconfoundedness:

$D(t) \perp X|r(t,x)$.

One can therefore estimate the average treatment effects by only conditioning on the GPS provided there is a sufficient overlap in the joint distribution of two marginal propensity scores. If for a given value of t, the distribution of $r(t,x)$ conditional on $T = t$ is similar to the distribution conditional on $T \neq t$, then all adjustment methods are likely to perform well.

The main difference between the multi-valued treatments and the binary-valued treatments is that the assignment probabilities in the latter add up to one. This by itself requires an additional condition, specifically, that the outcome is estimated conditionally on the joint distribution of the two conditioning sets (the intersection). If s is any value different from t in the set of treatments $\mathcal{T}$, this additional condition can be expressed:

$$E\{Y(t)|T = t, r(t,X), r(s,X)\} - E\{Y(s)|T = s, r(t,X), r(s,X)\}$$
$$= E\{Y(t) - Y(s)|r(t,X), r(s,X)\}$$

An important point to consider in the matching process is whether to match with or without replacement. Matching with replacement allows treated units to be matched with the same control unit, whereas matching without replacement requires no more than one treated unit to be matched with each control unit. While matching with replacement produces matches of higher quality, it may use control unit information inefficiently because several control units may remain unmatched and be excluded from the analysis. The question has been studied by Dehejia and Wahba (2002), Rosenbaum (2002) and Abadie and Imbens (2012).

The underlying idea is that to ensure estimator consistency, the quality of the matching should improve with increasing sample size. This would not happen if treated units remained unmatched. For matching without replacement, the sample must therefore contain more control than treated units, to avoid running out of control units before matching all the treated units; otherwise some treated units would be matched with unsimilar control units in imperfect matches. Thus, the fraction of treated units must be less than one half of the sample.

Abadie and Imbens (2012) concluded that large sample properties do not hold for the simple matching estimator because the latter includes a conditional bias term that may not vanish asymptotically. Their main contribution was to combine the matching estimator with an additional bias correction based on a nonparametric extension of the regression adjustment proposed by Rubin (1973) and Quade (1982). The results show that nonparametric bias correction removed the conditional bias asymptotically without affecting the variance. This created a consistent matching estimator.

However, the theory developed in Abadie and Imbens (2006 and 2012) to obtain consistent and asymptotically normal estimators using Propensity Score has not been extended to handle multivalued treatments, the statistical software (STATA) which we used to estimate the ATTs does not implement a Propensity Score option for multilevel treatment. We therefore applied the Inverse Probability Weighted Regression Adjustment (IPWRA)[17] which uses probability weights to obtain outcome-regression parameters. These adjusted parameters were then used to compute averages of treatment-level predicted outcomes. The differences of these averages provide estimates of treatment effects.

3.4 Data Sources and Description

The paper exploits the 2012 socio-economic survey conducted by the Palestine Central Bureau of Statistics (PCBS). The survey targeted 44,585 individuals across the West Bank including East Jerusalem (26,166 individuals) and the Gaza Strip (18,419 individuals) to represent the whole Palestinian population. It provides data on in-kind and cash aid received from MOSA and international organizations (UNRWA and others). It also provides data on food security and steadfastness of Palestinian households.

The survey provides details on heads of households, households themselves and the local community of reference. These characteristics were considered in the beneficiary selection procedure.

The main outcome variable of interest in this paper is the "food security index", calculated using a set of nine questions that reflect the extent to which Palestinian households fear a shortage of food.

The questions used to calculate the food security index are: In the last 30 days, did you worry that your household would not have enough food? Were you or any household member not able to eat the kinds of food you preferred because you couldn't afford them? Did you or any household member eat a limited variety of foods due to lack of money? Did you or any household member eat a smaller meal than you felt you needed because there was not enough food? Did you or any household member eat fewer meals in a day because there was not enough food? Was there ever no food at all in your house because there was no money to buy it? Did you or any household member go to sleep at night hungry because there was not enough food? Did you or any household member go a whole day and night without eating because there was not enough food?

An additional outcome variable of interest is steadfastness. To measure it another set of ten questions that reflect household steadfastness when faced with lack of food was used. The resulting measure is called the "steadfastness index" and it gauges the extent to which the household had to adapt to tackle lack of food.

The questions used to calculate the steadfastness index are: Did the family do any of the following to cope with the lack of food: eat stored food, collect wild plants, purchase food from low-quality markets, buy and consume fewer types of food items, reduce the

[17] STATA implements the IPWRA to measure the ATT via the command teffects ipwra.

proportion of food for adults in favour of children, reduce the number of meals, purchase food on credit, reduce food portions for all household members, ask for and receive aid from friends and/or relatives, and send women and/or children to work for food?

Both indices are additive and were calculated by summing the scores. Values range from 0 to 100. The closer to 100 the household score is, the more it is food secure. Questions for both indices were originally phrased in a negative way. To avoid confusion, the indices were converted so that higher scores indicated more food-secure households and less adaptation needed to tackle the lack of food. Both indices go in the same direction, with a correlation of 0.59.

The mean value of the food security index was 65.8 out of 100, and 56.8% of households were in the bottom 25% of the distribution, while only 6.74% of Palestinian households were in the upper 10%. The steadfastness index showed a lower mean value (22%), although 55.6% of Palestinian households were in the top 10% of the index distribution.

Direct aid of either type and from at least one provider reached 43.2% of Palestinian households at least once in the six months prior to the survey: 9.8% received food aid once, 63% received it twice, and only 6.7% received food aid on a monthly basis.

3.5 Estimation Results

Households were divided into three groups. The first group included households that benefited at least once from International Organizations (IO) aid programmes in the six months prior to the survey. Households in the second group benefited at least once from Palestinian Authority (PA) aid programmes in the six months prior to the survey (aid was mainly delivered through MOSA). The third group included households that benefited at least once from aid programmes of international organizations *and* the Palestinian Authority.

Beneficiary selection criteria differ: MOSA relies on socio-economic surveys conducted regularly across the West Bank and Gaza Strip and gathers data for specific poverty indicators, whereas international organizations tend to prioritize geographic locations like area C, Gaza and camps.

Three sets of characteristics were considered as pre-treatment variables: head of household, household and community characteristics. Head of household characteristics included age, income, educational level, marital status, employment/occupation status and type of employer. Household characteristics included number of family members, type of locality, type of house, land ownership and access to water. Finally, community characteristics included geopolitical area of Palestinian territory[18] and type of community (urban, rural).

[18] The Oslo agreement between the Palestinian Liberation Organization (PLO) and Israel in 1993 divided Palestinian territory into three geopolitical areas: Area A where the Palestinian Authority has administrative and military power, Area B where the Palestinian Authority has only administrative power, and Area C (58% of the West Bank) where Israeli forces have military and administrative power.

Table (3.1) shows the heterogeneity of the aid programmes in terms of beneficiary characteristics (age, schooling, etc). For example, the average age of heads of households receiving aid from international organizations was 43.4 years versus 51.2 years for those receiving aid from the Palestinian Authority. The same applied to gender and marital status.

The six treatments were calculated separately, considering type of aid (in-kind and cash): i) households receiving in-kind aid from IO (treated) versus households excluded from any type of aid (control); ii) households receiving cash aid from IO (treated) versus excluded[19] (control); iii) households receiving in-kind aid from the PA (treated) versus excluded (control); iv) households receiving cash aid from the PA (treated) versus excluded (control); v) households receiving in-kind aid from IO and PA versus excluded (control); vi) households receiving cash aid from IO and PA (treated) versus excluded (control).

[19] i.e. households excluded from any type of aid, whether in-kind or cash and whether from IO or PA.

Table 3. 1: Descriptive statistics of the three matching groups

			Matching I		Matching II		Matching III	
			IO vs. excluded		PA vs. excluded		IO and PA vs. excluded	
		Treatment 0	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
		Excluded/Control	(In-kind from IO)	(Cash from IO)	(In-kind from PA)	(Cash from PA)	(In-kind from PA and IO)	(Cash from PA and IO)
		n=4,964	n = 1,670	n = 141	n = 322	n = 255	n = 280	n = 340
Outcomes/Pre-treatment Variables	Definition	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Outcomes								
Steadfastness Index	Index (0-100) of the level of steadfastness of Palestinian individuals.	35.592 (13.793)	36.112 (17.714)	33.867 (17.872)	33.073 (18.181)	29.621 (15.732)	23.615 (15.593)	22.476 (16.050)
Food Security Index	Index (0-100) of the level of food security of Palestinian individuals.	90.087 (17.122)	70.580 (27.158)	73.051 (27.075)	73.118 (26.415)	79.729 (23.864)	85.396 (21.007)	86.024 (20.281)
Pre-treatment Variables								
Head of household characteristics								
Age	Individual's age in years.	43.6 (13.1)	43.4 (13.5)	45.4 (13.9)	51.2 (15.1)	53.0 (15.5)	48.6 (18.9)	55.0 (19.0)
Income	Average monthly income in NIS	3323.10 (2795.57)	1288.24 (1154.83)	1500.12 (1615.08)	1378.95 (1635.40)	1645.60 (3420.13)	2183.64 (4196.67)	1600.85 (1824.67)
Male	1 Male, 0 if Female.	0.954 (0.210)	0.918 (0.275)	0.929 (0.258)	0.730 (0.445)	0.729 (0.445)	0.796 (0.403)	0.653 (0.477)
Marital Status								

			Matching I		Matching II		Matching III	
			IO vs. excluded		PA vs. excluded		IO and PA vs. excluded	
		Treatment 0	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
		Excluded/Control	(In-kind from IO)	(Cash from IO)	(In-kind from PA)	(Cash from PA)	(In-kind from PA and IO)	(Cash from PA and IO)
		n=4,964	n = 1,670	n = 141	n = 322	n = 255	n = 280	n = 340
Outcomes/Pre-treatment Variables	Definition	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Single	1 Single, 0 Otherwise.	0.01 (0.11)	0.01 (0.08)	0.01 (0.08)	0.05 (0.22)	0.05 (0.22)	0.04 (0.19)	0.07 (0.25)
Engaged	1 Engaged, 0 Otherwise.	0.001 (0.038)	0.002 (0.049)	0.000 (0.000)	0.006 (0.079)	0.004 (0.063)	0.000 (0.000)	0.012 (0.108)
Married	1 Married, 0 Otherwise.	0.947 (0.225)	0.918 (0.275)	0.922 (0.269)	0.724 (0.448)	0.710 (0.455)	0.793 (0.406)	0.682 (0.466)
Divorced	1 Divorced, 0 Otherwise.	0.005 (0.068)	0.007 (0.084)	0.007 (0.084)	0.028 (0.165)	0.020 (0.139)	0.007 (0.084)	0.012 (0.108)
Widow/Widower	1 Widow, 0 Otherwise.	0.033 (0.178)	0.063 (0.244)	0.064 (0.245)	0.183 (0.387)	0.212 (0.409)	0.164 (0.371)	0.226 (0.419)
Separated	1 Separated. 0 Otherwise.	0.001 (0.038)	0.002 (0.042)	0.000 (0.000)	0.009 (0.096)	0.004 (0.063)	0.000 (0.000)	0.003 (0.054)
Educational Level								
Tawjihi & less	1 Tawjihi & less, O Otherwise.	0.726 (0.446)	0.863 (0.344)	0.894 (0.309)	0.950 (0.218)	0.914 (0.281)	0.896 (0.305)	0.847 (0.360)
Intermediate level diploma	1 Intermediate level diploma, 0 Otherwise.	0.073 (0.260)	0.056 (0.230)	0.021 (0.145)	0.016 (0.124)	0.047 (0.212)	0.032 (0.177)	0.059 (0.236)
Bachelor degree	1 Bachelor degree, 0 Otherwise.	0.168 (0.374)	0.077 (0.266)	0.078 (0.269)	0.034 (0.182)	0.039 (0.194)	0.061 (0.239)	0.082 (0.275)
Higher diploma	1 Higher diploma, 0 Otherwise.	0.002 (0.049)	0.001 (0.024)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Master degree and higher	1 Master degree, 0 Otherwise.	0.030 (0.171)	0.004 (0.065)	0.007 (0.084)	0.000 (0.000)	0.000 (0.000)	0.011 (0.103)	0.012 (0.108)

			Matching I		Matching II		Matching III	
			IO vs. excluded		PA vs. excluded		IO and PA vs. excluded	
		Treatment 0	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
		Excluded/Control	(In-kind from IO)	(Cash from IO)	(In-kind from PA)	(Cash from PA)	(In-kind from PA and IO)	(Cash from PA and IO)
		n=4,964	n = 1,670	n = 141	n = 322	n = 255	n = 280	n = 340
Outcomes/Pre-treatment Variables	Definition	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Employment/occupation status								
Employed	1 Employed, 0 Otherwise.	0.818 (0.386)	0.601 (0.490)	0.624 (0.486)	0.376 (0.485)	0.435 (0.497)	0.486 (0.501)	0.268 (0.443)
Unemployed	1 Unemployed, 0 Otherwise.	0.038 (0.192)	0.167 (0.373)	0.142 (0.350)	0.112 (0.316)	0.075 (0.263)	0.114 (0.319)	0.115 (0.319)
Out of labour force		0.143 (0.351)	0.232 (0.422)	0.234 (0.425)	0.512 (0.501)	0.490 (0.501)	0.400 (0.491)	0.618 (0.487)
Type of Employer								
National Private	1 if works in the national private organizations, 0 otherwise.	0.535 (0.499)	0.627 (0.484)	0.735 (0.444)	0.769 (0.423)	0.752 (0.434)	0.681 (0.467)	0.782 (0.415)
National Government	1 if works in the national government, 0 otherwise.	0.270 (0.444)	0.320 (0.467)	0.153 (0.362)	0.068 (0.253)	0.040 (0.197)	0.094 (0.292)	0.109 (0.313)
Foreign Government/UNRWA	1 if works in the foreign government or UNRWA or international organizations, 0 otherwise.	0.195 (0.397)	0.054 (0.225)	0.112 (0.317)	0.163 (0.371)	0.208 (0.408)	0.225 (0.419)	0.109 (0.313)

			Matching I		Matching II		Matching III	
			IO vs. excluded		PA vs. excluded		IO and PA vs. excluded	
		Treatment 0 Excluded/Control	Treatment 1 (In-kind from IO)	Treatment 2 (Cash from IO)	Treatment 3 (In-kind from PA)	Treatment 4 (Cash from PA)	Treatment 5 (In-kind from PA and IO)	Treatment 6 (Cash from PA and IO)
Outcomes/Pre-treatment Variables	Definition	n=4,964 Mean (SD)	n = 1,670 Mean (SD)	n = 141 Mean (SD)	n = 322 Mean (SD)	n = 255 Mean (SD)	n = 280 Mean (SD)	n = 340 Mean (SD)
Schooling	Total number of years of schooling.	11.057 (3.937)	9.838 (3.531)	9.172 (3.527)	8.456 (3.581)	8.840 (3.552)	9.606 (3.602)	9.440 (4.123)
Breadwinner	1 if he/she is the only breadwinner, 0 otherwise.	1.092 (0.289)	1.186 (0.389)	1.163 (0.371)	1.391 (0.489)	1.369 (0.483)	1.411 (0.493)	1.565 (0.497)
Household characteristics								
Members	Total number of household members.	5.533 (2.324)	6.358 (2.822)	6.546 (2.614)	5.752 (3.032)	5.435 (2.847)	4.189 (2.563)	3.438 (2.190)
Refugee	1 if registered refugee, 0 otherwise.	0.368 (0.482)	0.796 (0.403)	0.454 (0.500)	0.189 (0.392)	0.396 (0.490)	0.293 (0.456)	0.350 (0.478)
House								
Villa	1 lives in villa, 0 otherwise.	0.019 (0.135)	0.000 (0.000)	0.000 (0.000)	0.006 (0.079)	0.000 (0.000)	0.004 (0.060)	0.015 (0.121)
Traditional house	1 lives in traditional house, 0 otherwise.	0.512 (0.500)	0.368 (0.482)	0.525 (0.501)	0.658 (0.475)	0.651 (0.478)	0.636 (0.482)	0.488 (0.501)
Apartment	1 lives in apartment, 0 otherwise.	0.460 (0.498)	0.595 (0.491)	0.447 (0.499)	0.317 (0.466)	0.333 (0.472)	0.350 (0.478)	0.479 (0.500)
Tent/Independent room	1 lives in tent or independent room, 0 otherwise.	0.009 (0.096)	0.037 (0.189)	0.028 (0.167)	0.019 (0.135)	0.016 (0.125)	0.011 (0.103)	0.018 (0.132)

			Matching I		Matching II		Matching III	
			IO vs. excluded		PA vs. excluded		IO and PA vs. excluded	
		Treatment 0 Excluded/Control	Treatment 1 (In-kind from IO)	Treatment 2 (Cash from IO)	Treatment 3 (In-kind from PA)	Treatment 4 (Cash from PA)	Treatment 5 (In-kind from PA and IO)	Treatment 6 (Cash from PA and IO)
Outcomes/Pre-treatment Variables	Definition	n=4,964 Mean (SD)	n = 1,670 Mean (SD)	n = 141 Mean (SD)	n = 322 Mean (SD)	n = 255 Mean (SD)	n = 280 Mean (SD)	n = 340 Mean (SD)
Owned	1 if house is owned, 0 otherwise.	0.850 (0.357)	0.869 (0.338)	0.922 (0.269)	0.894 (0.308)	0.867 (0.341)	0.836 (0.371)	0.874 (0.333)
Water	1 if access to water network, 0 otherwise.	0.914 (0.281)	0.946 (0.227)	0.901 (0.300)	0.879 (0.327)	0.886 (0.318)	0.864 (0.343)	0.929 (0.257)
Land		1.835 (0.372)	1.952 (0.214)	1.872 (0.335)	1.854 (0.354)	1.835 (0.372)	1.807 (0.395)	1.803 (0.398)
Community Characteristics								
Area C	1 if lives in area C, 0 otherwise.	0.033 (0.178)	0.015 (0.121)	0.014 (0.119)	0.059 (0.236)	0.027 (0.164)	0.050 (0.218)	0.044 (0.206)
Urban	1 lives in urban area, 0 otherwise.	0.726 (0.446)	0.692 (0.462)	0.730 (0.445)	0.720 (0.449)	0.667 (0.472)	0.621 (0.486)	0.706 (0.456)
Rural	1 lives in rural area, 0 otherwise.	0.192 (0.394)	0.068 (0.252)	0.170 (0.377)	0.236 (0.425)	0.263 (0.441)	0.336 (0.473)	0.218 (0.413)
Camp	1 lives in refugee camp, 0 otherwise.	0.082 (0.275)	0.240 (0.427)	0.099 (0.300)	0.043 (0.204)	0.071 (0.257)	0.043 (0.203)	0.076 (0.266)
Gaza	1 lives in Gaza, 0 otherwise.	0.229 (0.420)	0.944 (0.229)	0.610 (0.490)	0.360 (0.481)	0.196 (0.398)	0.061 (0.239)	0.262 (0.440)

Source: Palestinian Central Bureau of Statistics Socio-economic survey, 2012. Own calculations.

3.6 Causal Effect of Treatments

Before we report the causal effects of treatments, we first assess any overlap in the distribution of covariates. The more balanced the characteristics of treated and control groups, the more accurate the measurement of causal effects. Balance can be tested by two measures: the standardized difference[20] of the distribution of a specific covariate between treated and control groups, and the variance ratio of the same covariates between the two groups. As we approach zero standardized difference and a variance ratio of one, we obtain more overlap in the distribution of the covariates of treated and control groups. To judge whether a specific covariate is balanced, we adopt the 25% cut-off point[21] proposed by Rubin (2001); for the variance ratio, values between 0.7 and 1.3 are deemed acceptable, as a rule of thumb.

Table (3.2) reports summary statistics for the pre-treatment variables balance test. The mean of the standardized difference in pre-treatment variables between treated and control groups varied between -0.003 in treatment 4 and -0.096 in treatment 3. The mean of the variance ratio varied between 0.79 in treatment 3 and 0.95 in treatment 1. While two pre-treatment variables proved to be unbalanced in treatment 4, eight were unbalanced in treatment 2. However, most covariates were balanced, providing a solid basis for measuring the causal effects of the treatments.

As we anticipated, we used the STATA's Inverse Probability Weighting Regression Adjustment to estimate treatments effects. IPWRA has three sequential steps: 1) it computes the inverse-probability weights after estimating the parameters of the multilevel treatment model; 2) it predicts the treatment-specific outcome of each household using the estimated inverse-probability weighted model; 3) it computes the mean of each treatment-specific outcome. The differences in these averages provide an estimate of the causal effect of treatments (StataCorp, 2021).

The Average Treatment Effect on the Treated (ATT)[22] measures the causal effect of treatments. Table (3.3) reports the ATT of the aid programmes on the food security and steadfastness indices. The estimates of the ATT are shown separately for in-kind and cash aid, with standard errors in brackets.

[20] The standardized difference is computed as the difference in mean weighted by the square root of corresponding average variances.

[21] As a rule of thumb, any standardized difference up to 25% is deemed acceptable.

[22] The ATT is the average treatment effect on those receiving the treatment. $ATT = E(y_1 - y_0|t = 1)$

Table 3.2: Balance test of pre-treatment covariates for six treatments

Pre-treatment Variables	Matching I				Matching II				Matching III			
	IO vs. excluded				PA vs. excluded				IO and PA vs. excluded			
	Treatment 1		Treatment 2		Treatment 3		Treatment 4		Treatment 5		Treatment 6	
	Standardized Difference	Variance Ratio	Standardized Difference	Variance Ratio	Standardized Difference	Variance Ratio	Standardized Difference	Variance Ratio	Standardized Difference	Variance Ratio	Standardized Difference	Variance Ratio
age	0.038	0.965	-0.048	1.005	-0.249	0.899	0.011	1.070	-0.299	1.178	0.189	0.830
income	-0.161	1.292	-0.114	2.143	-0.594	0.732	-0.029	1.263	-0.364	0.934	-0.074	1.285
Male	0.056	0.849	0.085	0.776	0.098	0.741	0.006	0.988	0.008	0.983	0.118	0.756
Marital status												
Engaged	0.024	1.248	-0.063	0.749	-0.073	0.785	0.008	1.042	-0.001	0.994	-0.100	0.717
Married	0.045	0.934	-0.090	1.127	0.191	0.711	0.019	0.996	-0.300	0.965	0.275	0.880
Divorced	0.065	2.366	-0.086	0.000	-0.024	0.749	0.002	1.030	-0.024	0.755	-0.029	0.787
Widow/Widower	-0.037	0.720	0.101	1.126	-0.085	0.360	-0.016	0.840	-0.012	0.878	-0.088	0.284
Separated	-0.033	0.622	-0.110	0.000	-0.110	0.000	0.000	0.000	0.000	0.000	0.000	0.464
Educational level	-0.009	1.010	0.139	1.167	0.109	1.000	0.003	0.913	0.031	1.055	-0.088	0.788
Unemployed	-0.032	0.938	-0.013	0.974	0.231	1.436	-0.008	0.982	0.041	1.097	-0.016	0.962
National Government	-0.057	0.952	-0.029	0.977	-0.547	0.424	-0.003	0.989	-0.246	0.325	0.138	1.261
Foreign Government/UNRWA	-0.118	0.734	-0.239	0.398	-0.003	0.992	-0.001	0.998	0.002	1.003	-0.086	0.845
Schooling	-0.031	1.077	0.108	1.137	0.133	1.004	0.007	1.081	-0.082	0.938	0.064	0.743
Bread Winner	-0.006	0.989	0.069	1.129	-0.097	0.816	0.035	1.041	0.044	1.050	-0.183	0.767
Members	-0.147	0.745	-0.232	0.720	-0.779	0.430	-0.049	0.525	0.162	1.192	-0.117	0.513
Refugee	-0.014	1.019	-0.720	1.427	-0.131	1.163	-0.036	0.981	-0.321	0.764	-0.315	0.770
Owned	0.080	0.840	0.231	0.726	0.035	0.930	0.039	0.924	0.226	0.569	0.179	0.655
Water	0.125	0.733	0.034	0.902	-0.165	1.208	-0.023	1.052	-0.167	1.270	-0.104	1.232
Land	0.162	0.623	0.278	0.384	0.263	0.414	0.024	0.976	0.155	0.832	0.143	0.846
Area C	-0.103	0.578	0.044	1.204	-0.182	0.713	-0.062	0.793	-0.223	0.336	-0.176	0.456
Rural	-0.005	0.984	0.163	1.181	0.159	1.266	0.004	1.002	-0.083	0.947	0.033	1.017

Pre-treatment Variables	Matching I				Matching II				Matching III			
	IO vs. excluded				PA vs. excluded				IO and PA vs. excluded			
	Treatment 1		Treatment 2		Treatment 3		Treatment 4		Treatment 5		Treatment 6	
	Standardized Difference	Variance Ratio	Standardized Difference	Variance Ratio	Standardized Difference	Variance Ratio	Standardized Difference	Variance Ratio	Standardized Difference	Variance Ratio	Standardized Difference	Variance Ratio
Camp	-0.081	0.911	-0.352	0.577	-0.446	0.457	0.004	1.012	-0.060	0.814	-0.036	0.886
Gaza	0.070	0.810	-0.139	1.403	0.050	0.864	0.005	1.011	0.174	1.280	-0.154	0.672
Mean	0.038	0.965	-0.048	1.005	-0.249	0.899	0.011	1.070	-0.299	1.178	0.189	0.830
SD	-0.161	1.292	-0.114	2.143	-0.594	0.732	-0.029	1.263	-0.364	0.934	-0.074	1.285

Source: the Palestinian Central Bureau of Statistics. Socio-economic survey, 2012. Own calculations.

The results show that the estimated impacts on food security and steadfastness were in similar ranges for both providers, though individual values differed. Either type of aid had a positive result on the food security index. Households receiving aid from international organizations were 10.4[23] and 11.3 points higher in the food security index for in-kind and cash aid, respectively, compared to non-participating households. Households receiving cash aid from the Palestinian Authority were 15.1 points higher in the food security index, but in-kind aid from the Palestinian Authority did not appear to make a significant difference.

Both aid providers had a positive and significant impact on the steadfastness index of treated households. Palestinian households that received aid from the international organizations were 10.6 and 11.2 points higher in the steadfastness index for in-kind and cash aid, respectively, than non-participating households. The same was true for recipients of PA aid, who scored 9.7 and 7.7 points higher in the steadfastness index for in-kind and cash aid, respectively.

The results from Matching III also show significant differences in ATTs for the two types of aid. Recipients of cash aid from international organizations and the Palestinian Authority were better off in terms of food security and steadfastness. However, the in-kind aid programs only appeared to make a significant difference in the steadfastness index. Overall, the results show greater efficacy of in-kind aid programs implemented by IOs than the Palestinian Authority.

Summing up, results across matching groups support the idea that cash aid programs administered by the international organizations or the Palestinian Authority pay dividends in terms of food security, which in turn is evidence that aid providers are making progress towards achieving the MDGs. However, in-kind aid programs only seemed to be effective when administered by the international organizations.

Table 3. 3: The Average Treatment Effect of the Treated (ATT) of in-kind and cash aid on the Steadfastness and Food Security indices

	Food Security Index	Steadfastness index
	Variation in the index (Std. Err.)	Variation in the index (Std. Err.)
IO		
In-kind	10.431 (1.156)***	10.639 (1.723)***
Cash	14.313 (3.338)***	11.215 (3.168)***
PA		
In-kind	10.271 (5.821)	9.473 (4.677)*
Cash	15.138 (1.323)***	7.695 (1.283)***
IO and PA		
In-kind	8.769 (11.358)	7.535 (1.992)***
Cash	20.884 (1.544)***	4.699 (2.232)*

t statistics in brackets * p<0.05, ** p<0.01, *** p<0.001

[23] The food security index showed that households receiving in-kind aid from international organizations are (on average) 10.4 more numerous than households that did not receive any kind of aid. The former received 75.5 out of 100 versus 65.1 for the latter.

3.7 Discussion and Conclusions

Donors and international organizations investing in relief and development projects have recently emphasized the importance of monitoring the final impact of their interventions on the Palestinian standard of living. Impact measurement has encountered several challenges, the biggest of which is the lack of credible and accurate data. To bridge this gap, donors channelled funds to the Palestinian Central Bureau of Statistics (PCBS) as well as private consulting firms with a view to fostering the design and implementation of appropriate surveys.

Although the PCBS provided plenty of data useful for impact evaluation of donor-funded projects, most evaluations continued to be focused at macroeconomic level with a clear lack of data-driven reporting at micro level. This paper exploited the household socio-economic survey conducted across the West Bank (including East Jerusalem) and the Gaza Strip in a first step towards filling this information gap.

The paper evaluated the extent to which aid provided to the Palestinian population living in the West Bank[24] and Gaza Strip was effective in enhancing food security and steadfastness. The Average Treatment Effect of the Treated was estimated using generalized propensity-score matching which gauges causal effects by minimizing heterogeneity of characteristics in comparing beneficiaries (the treated) and excluded households (controls).

The data indicates that 43.2% of Palestinian households received direct aid from a provider at least once in the six months prior to the survey. Around ten percent (9.8%) received food aid once, and 63% received it twice, with only 6.7% receiving food aid on a monthly basis. The data also shows that more than half Palestinian households (56.8%) are situated in the bottom 25% of the food security index distribution. Accordingly, this study recommends finding a new strategy to increase the number of beneficiaries of direct aid (cash and/or in-kind).

In line with expectations, the results indicate that households who received cash or in-kind aid from the international organizations or cash aid from the Palestinian Authority were better off in terms of food security and steadfastness. The increase in food security and steadfastness indices due to these treatments was at least 8.8% and 4.7%, respectively. International organizations appeared to achieve better results than the Palestinian authority but only through their in-kind programme. The causal effect of cash aid administered by either provider was similar.

[24] Whenever the West Bank is mentioned, it includes East Jerusalem.

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