Essays on three major development issues in Pakistan

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I declare that the material contained in this thesis is entirely my own work, except where due and accurate acknowledgement of another source has been made.

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To my parents, whom I am proud of.

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I being the co-author of chapter 2 of this thesis titled ‘Environmental implications of agricultural externality: policy for socially optimal output’, and published in *Journal of Quantitative Economics,* vol. 13, no.1, pp. 87-100, declare that Mr. Tufail Khan Yousafzai’s contributions in this published work are substantial and that I was only the second author of this publication.

Kaliappa Kalirajan

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Abstract

This thesis comprises of three independent, but self-contained, chapters relating to economic development of Pakistan. While the first chapter is general and theoretical, the other two chapters are empirical.

Chapter 2 is a theoretical analysis of the existence of agricultural externality when the cause of externality is not only the presence of sub-soil hydrological contamination but also the method of application of agricultural technology, otherwise known as 'efforts.' The analysis demonstrates that individual optimization of agricultural production activities leads to socially undesireable outcomes when the upstream farmer does not take into account the costs associated with the flow of pollutants generated by the upstream farmer on the downstream farmer. The analysis suggests that an optimal agricultural policy choice would be to taxing not only the flow of contaminants, but aso the efforts.

Chapter 3 analysis the impact of abolition of the Multi-Fibre Agreement (MFA) on Pakistan's export of textiles and clothing sectors. Using the stochastic frontier gravity model and calculating the revealed comparative advantage (RCA) indices, the results show that the abolition of the MFA does not have a significant impact on Pakistan's export of textiles sub-sector. Also, the mean-export efficiency of textiles has shown a decreasing trend over time. In contrast, the abolition of the MFA has a significant positive impact on Pakistan's export of clothing sub-sector with the mean-export efficiency showing an increasing trend over time. Calculation of revealed comparative advantage reveals that Pakistan has maintained post-MFA comparative advantage in a wide range of its textiles and clothing products.

Chapter 4 investigates the average and marginal spending behaviour of households in Pakistan that receive international remittances. Using nationally representative household income and expenditure survey data for Pakistan, this chapter analysis the households' spending behaviour on five different categories of goods: food, education, health, non-durables and durables. Using a counterfactual framework, a two-stage Heckman model is used to address the selection in unobservable heterogeneity. Two findings emerge. First, expenditure share on food for households that receive remittances would have been more if the households had not been receiving

remittances. Similarly, less spending on the other four categories of education, health, non-durables and durables is predicted for remittances-receiving households had they not been receiving remittances. Second, households that receive remittances spend less at the margin on food and durables and more on education, health and non-durables. Remittances-receiving households appear to look at the remittance earnings as a transitory income and therefore tend to spend remittances more on investment than consumption.

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Chapter 1 Introduction

The developing world faces diverse and different issues of development. Though a reasonable commonality exits in the issues of development faced by the developing countries as a whole, each country has specific development facets that are structurally rooted and have a long reach. More often than not, the macro as well as the micro economic foundations of developing countries are pinned on few sectors, such as, agriculture or trade in specific commodities. Hence, a shock to these vulnerable sectors has far reaching consequences for the macro-economic stability of the economy and the poverty dynamics of the households. Against this backdrop, this thesis aims to identify and address some of the issues of relevance to the economic development of Pakistan. Although this thesis does not follow a single topic, each chapter in its own right addresses, in this author's opinion, one important aspect of economic development of Pakistan. A brief overview of each of the four chapters following this chapter is given.

The second chapter of this thesis, 'Environmental Implications of Agricultural Externality: Policy for Socially Optimal Output', provides a theoretical analysis of the existence of agricultural externality when the cause of externality is not only the presence of sub-soil hydrological contamination, but also the method of application of agricultural technology, i.e., the effort. The model in an extensive way, enriches the basic model developed by Marshall and Homans (2001) and takes into account the simultaneous existence of the aforementioned causes of agricultural externality. The analysis demonstrates that individual optimization of agricultural production activities leads to socially undesireable outcomes when the upstream farmer does not take into account the costs associated with the flow of pollutants generated on the downstream farmer. The analysis suggests that an optimal agricultural policy choice would be taxing not only the flow of contaminants, but also the efforts.

The third chapter, 'Impact of the abolition of the Multi-Fibre Agreement on Pakistan's export of textiles and clothing: An empirical analysis', tests the resilience of Pakistan's textiles and clothing exports in the aftermath of the abolition of Multi-Fibre Agreement (MFA). The textiles and clothing sectors have important social and economic bearings in the short run by providing employment, increasing incomes and improving trade balance and in the long run by providing an opportunity for sustained economic development (Keane & de Velde 2008). Textiles and clothing exports contributed over

56 per cent of total exports in the financial year 2010-11, contributed 7.5 per cent to the total GDP and provided employment to about 40 per cent of the labour force involved in manufacturing (Pakistan Economic Survey 2010-11). As such, improving export efficiencies in the textiles and clothing sectors is of paramount importance to the Poverty Reduction Strategy of Pakistan (IMF 2004). Against this backdrop, this paper estimates the impact of the abolition of the MFA on Pakistan's export of textiles and clothing sub-sectors. A stochastic frontier gravity model is used for estimation and the revealed comparative advantage (RCA) indices are also calculated for a wide range of textile and clothing products. Results show that the abolition of the MFA does not have a significant impact on Pakistan's export of textiles sub-sector. Also, the mean-export efficiency of textiles has shown a decreasing trend over time. In contrast, the abolition of the MFA has had a significant positive impact on Pakistan's export of clothing sub-sector with the mean-export efficiency showing an increasing trend over time. Calculation of revealed comparative advantage reveals that Pakistan has maintained post-MFA comparative advantage in a wide range of its textiles and clothing products. However, with 70 per cent of Pakistan's total export of textiles and clothing being concentrated in the textiles sector and given the important contribution of the textiles sector to the GDP of Pakistan, declining efficiency in export of textiles sector will impair overall economic growth of Pakistan.

The fourth chapter, 'The Economic Impact of International Remittances on Household Consumption and Investment in Pakistan', investigates the consumption behaviour of remittances-receiving and non-receiving households in Pakistan. During the last decade there has been a phenomenal increase in the flow of international remittances received by the developing countries in general, and Pakistan in particular. In 2013, officially recorded remittances to Pakistan amounted to US $14.6 billion and were six times more than the official development assistance received. In order to investigate how the receipt of international remittances affects the average and marginal spending behaviour of households, this chapter uses nationally representative household income and expenditure survey data for Pakistan to analyse households' consumption behaviour on five different categories of goods: food, education, health, non-durables and durables. Understanding that the decision of a household member to migrate and remit money may not be taken at random, and to control for endogeneity, a two-stage Heckman model is used to address the selection in unobservable heterogeneity. Two findings emerge. First, the expenditure share on food for households that receive remittances would have been more if the households had not been receiving remittances. Similarly, less spending on the other four categories of education, health, non-durables and durables is predicted for remittances-receiving households had they not been receiving remittances. Second, households that receive remittances spend less at the margin on food and durables and more on education, health and non-durables. Compared to households that do not receive remittances, the households receiving remittances spend, at the margin, 10 per cent and 4 per cent less on consumption of food and durables, respectively. Moreover, the respective marginal increase in spending on education and health is 26 per cent and 6 per cent more for a remittances-receiving household than for a non-receiving household. Finally, the households receiving remittances spend, at the margin, 14 per cent more on non-durables (which includes their spending on housing, and is thus akin to investment in physical capital) than the households with no remittances. A key policy feature of these results is the likely positive impact of remittances on economic development. Remittances provide an alternative way to finance development by the way of increased spending on human capital or education as well as physical capital. Remittances-receiving households appear to look at the remittance earnings as a transitory income and therefore tend to spend remittances more on investment than consumption. This finding lends support to the permanent income hypothesis.

The final and fifth chapter concludes the findings of thesis.

Chapter 2 Environmental implications of agricultural externality: policy for socially optimal output

Abstract

Agriculture externality is caused not only by the presence of a hydrological contamination (a state variable) but also by the method of application of agricultural technology (the control variable), otherwise known as 'efforts'. This paper demonstrates that individual optimization of agricultural production activities leads to socially undesirable outcomes when the upstream farmer does not take into account the costs associated with the flow of pollutants generated on the downstream farmer. The paper suggests that an optimal agricultural policy choice would be to tax not only the flow of contaminants, but also the efforts.

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2.1 Introduction

Sustainable agriculture is crucial to ensuring global food security. The long-run sustainability of agriculture depends on the ability of agroecosystems to remain productive. Further, an important aspect of sustainability concerns ecological or environmental sustainability, too. In its capacity as a source, the global ecosystem provides the flow of useful goods and services, such as food, water, air and energy. Its sink capacity helps assimilate output and wastes (Goodland 1995). Environmental sustainability requires unimpaired maintenance of the source and sink capacities of global ecosystems.

Farmers' agricultural decision-making processes consist of a profitable combination of inputs based on the natural capital of soil, water, fossil fuel and, inputs derived from human made capital such as fertilizers, pesticides and seeds. More important than what inputs are being used is the way these inputs are applied. Generally, the method of application of the chosen technology, which is otherwise called 'efforts', usually involves intensifying the use of human made capital to increase agricultural output without properly following scientifically recommended practices. The outcome, though desirable in terms of an increase in levels of outputs, would be undesirable in most cases in terms of emission of contaminants to the environment. Such a production behaviour has an impact on the sustainability of current agroecosysems. Herdt and Steiner (1995) raised doubts about the sustainability of the current agroecosystems in the sense of remaining productive in the long run as the increased use of human made capital may result in degradation of natural capital and thus impair the underlying productive capacity.

Eswaran et al. (2001) observed that intensive farming can cause yield reductions of 50 per cent and more in some environments. For example, in the Indian agriculture context, though fertilizer consumption increased from 122.97 tonnes per 1000 hectare in 2008 to 134.23 tonnes per 1000 hectare in 2009, the yield of rice declined from 3.25 tonnes per hectare in 2008 to 3.24 tonnes per hectare in 2009 (FAO, 2014). With respect to subsidies, during the Fiscal Year 12 (FY12) (April 2011 to March 2012), India subsidised fertiliser use by $15,171 million, irrigation by $6,303 million, electricity consumption by farmers by $7,326 million, and other inputs such as seed, tractors and crop insurance by $8,832 million. Thus, the total subsidy in FY12 was estimated to be about 2.2 percent of the GDP. Thus, the impact of the method of application of the agricultural technology at the field level on the exchequer is an important agricultural externality, too.

In this context, leaving aside the economic externality of the stress on the exchequer through increased subsidy, it is important to realize the existence of a negative environmental externality that is generated as a by-product of efforts in the form of flow of undesired emissions (hydrological contaminants). The latter refers generically to inappropriate use of any of the agriculture inputs, for example, overuse of irrigation water, or overuse of fertilizers and pesticides. Baumol and Oates (1988, p.17) have argued that “an externality is present whenever some individual’s (say A’s) utility or production relationships include real (that is, nonmonetary) variables, whose values are chosen by others (persons, corporations, governments) without particular attention to the effects on A’s welfare.” It is now an established fact that if production decisions do not incorporate the disutility of the affected individuals, then over-production from the socially optimal level will take place and an excessive amount of contamination will be produced. For example, let us consider from Figure 2.1 of Appendix 2A , the upward sloping private marginal cost (supply) curve (S_1) of a producer for a given downward sloping demand curve (D) and the equilibrium output of some agricultural commodity to be Q. It is assumed that the production technology produces different types of contaminants such as air pollution and water pollution that contribute to the health problems of people living in the vicinity. If the cost of dealing with these problems for the affected people is considered in the decision making process of the producer, then the marginal cost curve, which is now the 'social marginal cost' curve, will shift upward (S_2) and will produce a new equilibrium Q*, which will be less than Q. The area CDGB is the externality to be valued for the market output Q, given the shapes of the curves. The net social benefit from producing Q output is not CAB, but (CAB – CDGB). Thus, a generally recognized solution is to internalize the external cost of production externalities in the original production decisions.

This paper analyses the environmental externality of agricultural production in a dynamic and spatial context and extends the findings of previous work by Marshall and Homans (2001), who assumed externality to be a function of either hydrological contamination only or efforts only. In this study, agricultural externality is considered as a function of both hydrological contamination and efforts. Steady-state analysis of a dynamic agricultural production model is used to analyse the interaction of efforts and contaminant flow and it is illustrated why some sort of regulatory intervention will be required even if the producers incorporate the cost of abatement in their individual production decisions. It is concluded that when the externality is caused by both the presence of hydrological contamination and the inappropriate use of agricultural technology, then taxing both aspects of agriculture will be the optimal policy for a social planner from the country's welfare point of view.

The following section describes the model and the propositions formulated to examine the characteristics of the environmental externality of agricultural production in a dynamic and spatial context. Section 3 provides policy options for achieving socially optimal output.

2.2 Model description

Following Marshall and Homans' (2001) formulation, the model consists of two producers with identical production functions. Each producer produces according to the following quadratic production function[1]:

[1] Use of the quadratic production function is consistent with agronomics studies. Datta *et al*. (1998) estimate the yield of wheat under salinity using different production functions and concludes that a quadratic production function gives the best results.

$$Q_i = x_i - \alpha x_i^2 - h_i^2 - \beta a_i^2 \quad (1)$$

where x_i is the effort applied (a control variable), h_1 is the level of hydrological contamination (a state variable) and a_i is the abatement level (a control variable). Agricultural effort x_i, is assumed to be a generic term and implies inefficient application of inputs such as, irrigation water, fertilizers, pesticides and the like. The model also assumes overall convexity for the production function. Suppose that agricultural decision making unit (DMU) 1 lies upstream so that hydrological contaminants flow downstream from DMU 1 to DMU 2 and are then released out of the system. The state equations for each of the respective DMUs are

$$\dot{h}_1 = x_1 - a_1 - flow1 \text{ and,} \quad (2)$$

$$\dot{h}_2 = x_2 - a_2 + flow1 - flow2 \quad (2a)$$

The model assumes that the spatial externality is caused not only by the presence of hydrological contamination but also by the intensified agricultural effort. As such, the flow is considered to be an additively separable function of some percentage 'σ' of the existing stock of hydrological contamination and a percentage 'η' of the agricultural effort, that is,

$$flow_1 = \sigma h_1 + \eta x_1 \text{ and,} \quad (3)$$

$$flow_2 = \sigma h_2 + \eta x_2 \quad (3a)$$

The soil in both the DMUs is assumed to have the same physical properties so that the flow factors σ and η are the same for the two units. The objective is to work out the socially optimal levels of the state variable (*h*) and the control variables (*x* and *a*).

2.2.1 Private optimization

First, consider the case of non-intervention from a social planner. In this scenario, the private optimizer in DMU 1 optimizes

$$max_{<x_1,a_1>} Q_1 = \int_0^\infty e^{-rt} (x_1 - \alpha x_1^2 - h_1^2 - \beta a_1^2) \text{ subject to} \quad (4)$$

$$\dot{h}_1 = x_1 - a_1 - (\sigma h_1 + \eta x_1)$$

The current valued Hamiltonian, $\mathcal{H}$, for the functional given by equation (4) is

$$\mathcal{H} = x_1 - \alpha x_1^2 - h_1^2 - \beta a_1^2 + \mu_1(x_1 - a_1 - \sigma h_1 - \eta x_1) \tag{5}$$

where, $\mu_1(t)$ can be interpreted as the marginal (imputed) value or shadow price of the state variable, $h_i(t)$. Therefore, $\mu_1(0)$ is the amount by which Q_i^* (the maximum value function) would decrease if, $h_i(0)$ (the initial value of the state variable) were to increase by a small amount.

The necessary conditions for the optimal solution are $\partial\mathcal{H}/\partial x_1 = 0$ and $\partial\mathcal{H}/\partial a_1 = 0$. The solution to these conditions along with the state equation, gives the following system of differential equations:

$$\dot{\mu}_1 = (r + \sigma)\mu_1 + 2h_1 \tag{6}$$

$$\dot{h}_1 = \frac{\alpha + (1-\eta)^2\beta}{2\alpha\beta}\mu_1 - \sigma h_1 + \frac{(1-\eta)}{2\alpha} \tag{6a}$$

Steady-state equilibrium is obtained by setting $\dot{\mu}_1 = \dot{h}_1 = 0$. This yields

$$\overline{\mu}_1^p = -\frac{(1-\eta)}{\alpha|A^p|}, \tag{7}$$

$$\overline{h}_1^p = \frac{(1-\eta)(r+\sigma)}{2\alpha|A^p|}, \tag{7a}$$

$$\overline{x}_1^p = \frac{1}{2\alpha}\left[1 - \frac{(1-\eta)^2}{\alpha|A^p|}\right] \tag{7b}$$

and

$$\overline{a}_1^p = \frac{1}{2\beta}\left[\frac{(1-\eta)}{\alpha|A^p|}\right] \tag{7c}$$

where $|A^p|$ is the absolute value of the determinant of the coefficients of homogeneous equations corresponding to the differential equations (6) and (6a) given by

$$A^p = -\left[\sigma(r+\sigma) + \left(\frac{\alpha + (1-\eta)^2\beta}{\alpha\beta}\right)\right] < 0,$$

Therefore, the equilibrium is a saddle point.

Likewise, the private optimizer in DMU 2 optimizes

$$max_{<x_2,a_2>} Q_2 = \int_0^{\infty} e^{-rt} \left(x_2 - \alpha x_2^2 - h_2^2 - \beta a_2^2\right) \quad \text{subject to}$$

$$\dot{h}_2 = x_2 - a_2 + (\sigma h_1 + \eta x_1) - (\sigma h_2 + \eta x_2)$$

The resulting differential equations are

$$\dot{\mu}_2 = (r+\sigma)\mu_2 + 2h_2 \qquad (8)$$

$$\dot{h}_2 = \left(\frac{\alpha+(1-\eta)^2\beta}{2\alpha\beta}\right)\mu_2 - \sigma h_2 + \frac{(1-\eta)}{2\alpha} + \sigma h_1 + \eta x_1 \qquad (8a)$$

The steady-state solution is again a saddle point equilibrium and is given by

$$\overline{\mu}_2^p = -\frac{1}{\alpha|A^p|^2}\left[\sigma(r+\sigma)(2-\eta) + \left(\frac{\alpha+(1-\eta)^3\beta}{\alpha\beta}\right)\right] \qquad (9)$$

$$\overline{h}_2^p = \frac{(r+\sigma)}{2\alpha|A^p|^2}\left[\sigma(r+\sigma)(2-\eta) + \left(\frac{\alpha+(1-\eta)^3\beta}{\alpha\beta}\right)\right] \qquad (9a)$$

$$\overline{x}_2^p = \frac{1}{2\alpha}\left[1 - \frac{(1-\eta)}{\alpha|A^p|^2}\left\{\sigma(r+\sigma)(2-\eta) + \left(\frac{\alpha+(1-\eta)^3\beta}{\alpha\beta}\right)\right\}\right] \qquad (9b)$$

and

$$\overline{a}_2^p = \frac{1}{2\beta}\left[\frac{1}{\alpha|A^p|^2}\left\{\sigma(r+\sigma)(2-\eta) + \left(\frac{\alpha+(1-\eta)^3\beta}{\alpha\beta}\right)\right\}\right] \qquad (9c)$$

Proposition 1. The private optimal solutions in both the DMUs are equal if and only if $\sigma = \eta = 0$, that is, when the cause of externality does not exist.

This is an obvious illustration of the fact that the decision of the upstream farmer has no effect on the production decision of the downstream farmer. In this case, there will be no wedge between the private optimal solutions in each of the DMUs and the socially optimal solution.

Proposition 2. For any positive values of σ and η, individual optimization results in higher equilibrium levels of hydrological contamination and abatement levels and a lower equilibrium effort level in DMU 2, that is, for $\sigma, \eta > 0$; $\overline{\mathrm{h}}_2^{\mathrm{p}} > \overline{\mathrm{h}}_1^{\mathrm{p}}$; $\overline{\mathrm{a}}_2^{\mathrm{p}} > \overline{\mathrm{a}}_1^{\mathrm{p}}$ and $\overline{\mathrm{x}}_2^{\mathrm{p}} < \overline{\mathrm{x}}_1^{\mathrm{p}}$ [For proof, refer to the Appendix 2B]

This happens because private optimization in downstream DMU 2 is sensitive to upstream contaminant levels and agriculture efforts. Private optimization in upstream DMU 1 takes into account the discounted future costs to itself only, and does not consider the costs it imposes on the downstream DMU 2. As such, the downstream producer takes the inflow of contaminants from the upstream DMU 1 in current and all future periods as given and optimizes accordingly. This results in a higher equilibrium concentration of hydrological contaminants in the downstream DMU 2 along with higher abatement costs. Thus, an externality exists.

2.2.2 Social optimization

Having realized that an externality is being imposed on the downstream producer by the individual decisions of the upstream producer, it is important to see the role of a social optimizer in this context. A social optimizer who optimizes the aggregate output of the landscape would take into account not only the discounted future costs that accrue to the upstream DMU 1, but also the discounted future costs of the decisions taken by the upstream DMU 1 on the production decisions of the downstream producer. A social optimizer optimizes

$$max_{<x_1, x_2, a_1, a_2>} Q = \int_0^\infty e^{-rt}\{(x_1 - \alpha x_1^2 - h_1^2 - \beta a_1^2 +) + (x_2 - \alpha x_2^2 - h_2^2 - \beta a_2^2)\} \qquad (10)$$

such that

$$\dot{h}_1 = x_1 - a_1 - (\sigma h_1 + \eta x_1) \text{ and}$$

$$\dot{h}_2 = x_2 - a_2 + (\sigma h_1 + \eta x_1) - (\sigma h_2 + \eta x_2)$$

The current valued Hamiltonian, $\mathcal{H}$, for the functional given by equation (10) is

$$\mathcal{H} = x_1 - \alpha x_1^2 - h_1^2 - \beta a_1^2 + x_2 - \alpha x_2^2 - h_2^2 - \beta a_2^2 + \mu_1[(1-\eta)x_1 - a_1 - \sigma h_1] + \mu_2[(1-\eta)x_2 - a_2 + \sigma h_1 - \sigma h_2 + \eta x_1]$$

Solving the necessary conditions ($\partial\mathcal{H}/\partial x_1 = 0$; $\partial\mathcal{H}/\partial x_2 = 0$; $\partial\mathcal{H}/\partial a_1 = 0$; $\partial\mathcal{H}/\partial a_2 = 0$) yields the following system of differential equations:

$$\dot{\mu_1} = (r+\sigma)\mu_1 - \sigma\mu_2 + 2h_1 \qquad (11)$$

$$\dot{\mu_2} = (r+\sigma)\mu_2 + 2h_2 \qquad (11a)$$

$$\dot{h}_1 = \frac{\alpha+(1-\eta)^2\beta}{2\alpha\beta}\mu_1 + \frac{\eta(1-\eta)}{2\alpha}\mu_2 - \sigma h_1 + \frac{(1-\eta)}{2\alpha} \qquad (11b)$$

$$\dot{h}_2 = \frac{\eta(1-\eta)}{2\alpha}\mu_1 + \left[\frac{\alpha+\{(1-\eta)^2+\eta^2\}\beta}{2\alpha\beta}\right]\mu_2 + \sigma h_1 - \sigma h_2 + \frac{1}{2\alpha} \qquad (11c)$$

The socially optimal steady-state solutions are given in Table 2.1 along with their comparisons with the private optimal solutions.

Table 2.1 Comparison of socially and private optimal steady-state equilibriums

Variable	Socially optimal steady-state[a]	Private optimal steady-state	Comparison
x_1	$\overline{x}_1^s = \frac{1}{2\alpha}\left[1 - \frac{1}{\alpha\lvert A^s\rvert}\left\{(2-\eta)(1-\eta)\sigma^2 + \sigma(r+\sigma) + ((1-\eta)^2 + \eta)\left(\frac{\alpha+(1-\eta)^2\beta}{\alpha\beta}\right) - \frac{\eta(1-\eta)^2}{\alpha}\right\}\right]$	$\overline{x}_1^p = \frac{1}{2\alpha}\left[1 - \frac{(1-\eta)^2}{\alpha\lvert A^p\rvert}\right]$	$\overline{x}_1^p > \overline{x}_1^s$
h_1	$\overline{h}_1^s = \frac{(1-\eta)}{2\alpha\lvert A^s\rvert}\left[\sigma(r+\sigma)^2 + \left\{r - \frac{\eta}{1-\eta}\sigma\right\}\left\{\frac{\alpha+(1-\eta)^2\beta}{\alpha\beta}\right\} - \frac{r\eta(1-\eta)}{\alpha}\right]$	$\overline{h}_1^p = \frac{(1-\eta)(r+\sigma)}{2\alpha\lvert A^p\rvert}$	$\overline{h}_1^p > \overline{h}_1^s$
a_1	$\overline{a}_1^s = \frac{1}{2\beta}\left[\frac{1}{\alpha\lvert A^s\rvert}\left\{(2-\eta)\sigma^2 + (1-\eta)\sigma(r+\sigma) + (1-\eta)\left[\frac{\alpha+\{(1-\eta)^2+\eta^2\}\beta}{\alpha\beta}\right] - \frac{\eta(1-\eta)}{\alpha}\right\}\right]$	$\overline{a}_1^p = \frac{1}{2\beta}\left[\frac{(1-\eta)}{\alpha\lvert A^p\rvert}\right]$	$\overline{a}_1^p < \overline{a}_1^s$
x_2	$\overline{x}_2^s = \frac{1}{2\alpha}\left[1 - \frac{(1-\eta)}{\alpha\lvert A^s\rvert}\left\{\sigma(r+\sigma)(2-\eta) + \left(\frac{\alpha+(1-\eta)^3\beta}{\alpha\beta}\right)\right\}\right]$	$\overline{x}_2^p = \frac{1}{2\alpha}\left[1 - \frac{(1-\eta)}{\alpha\lvert A^p\rvert^2}\left\{\sigma(r+\sigma)(2-\eta) + \left(\frac{\alpha+(1-\eta)^3\beta}{\alpha\beta}\right)\right\}\right]$	$\overline{x}_2^p < \overline{x}_2^s$
h_2	$\overline{h}_2^s = \frac{(r+\sigma)}{2\alpha\lvert A^s\rvert}\left[\sigma(r+\sigma)(2-\eta) + \left(\frac{\alpha+(1-\eta)^3\beta}{\alpha\beta}\right)\right]$	$\overline{h}_2^p = \frac{(r+\sigma)}{2\alpha\lvert A^p\rvert^2}\left[\sigma(r+\sigma)(2-\eta) + \left(\frac{\alpha+(1-\eta)^3\beta}{\alpha\beta}\right)\right]$	$\overline{h}_2^p > \overline{h}_2^s$
a_2	$\overline{a}_2^s = \frac{1}{2\beta}\left[\frac{1}{\alpha\lvert A^s\rvert}\left\{\sigma(r+\sigma)(2-\eta) + \left(\frac{\alpha+(1-\eta)^3\beta}{\alpha\beta}\right)\right\}\right]$	$\overline{a}_2^p = \frac{1}{2\beta}\left[\frac{1}{\alpha\lvert A^p\rvert^2}\left\{\sigma(r+\sigma)(2-\eta) + \left(\frac{\alpha+(1-\eta)^3\beta}{\alpha\beta}\right)\right\}\right]$	$\overline{a}_2^p > \overline{a}_2^s$

Note: a$\lvert A^s\rvert$ is the absolute value of the determinant of the coefficient matrix of the homogeneous equations corresponding to the differential equations (11) and (11c) and is given by:

$$\lvert A^s\rvert = \left[\sigma(r+\sigma) + \frac{\alpha+(1-\eta)^2\beta}{\alpha\beta}\right]^2 + \left(\frac{\alpha+(1-\eta)^2\beta}{\alpha\beta}\right)\left(\sigma^2 + \frac{\eta^2}{\alpha}\right) + \frac{\eta}{\alpha}\left[\sigma(r+\sigma) + (1-\eta)\left(\sigma^2 - \frac{\eta(1-\eta)}{\alpha}\right)\right]$$

Proposition 3. In the case of externality/flow being a function of the state variable h, *only ($\sigma \neq 0$, $\eta = 0$), the relative size of the flow factor σ, and the discount factor r, determines the relative size of socially optimal equilibrium levels of agricultural effort and abatement in the two DMUs. The socially optimal equilibrium levels of agricultural effort and abatement in the two DMUs are equal only if $\sigma = r$. If $\sigma > r$, then $\overline{a}_1^s > \overline{a}_2^s$ and $\overline{x}_1^s < \overline{x}_2^s$ and if $\sigma < r$, then $\overline{a}_1^s < \overline{a}_2^s$ and $\overline{x}_1^s > \overline{x}_2^s$. However,* *irrespective of the direction of inequality between σ and r*, $\overline{h}_1^s < \overline{h}_2^s < \overline{h}_2^p$. (For proof, refer to the Appendix 2B)

In the case of externality being a function of the control variable x, only (σ=0, η≠0), optimal levels of abatement and agricultural effort in the two cells are insensitive to r and only the state variable h is sensitive to r.

When the discount rate is lower than the rate of flow of externality (σ) , and externality is caused by existing hydrological contamination only, a social optimizer requires a higher abatement cost for the upstream DMU 1. This is because the upstream DMU 1 will tend to offset the higher discounted future cost to itself by engaging in more agricultural effort and releasing a higher proportion of flow into the downstream DMU 2. The marginal cost of this increased flow into the downstream DMU 2 is also taken into account by a social planner who inflicts a higher abatement cost on the upstream DMU 1. The opposite happens when r is higher than σ .

When the flow of externality is related to agricultural effort only, the socially optimal levels of abatement and effort are not related to the discount rate. This means that in each period, the downstream DMU 2 bears the full cost of upstream agricultural activity by responding with a higher abatement activity in the same period (Marshall and Homans, 2001).

Proposition 4. For any positive discount rate $(r \geq 0)$, *the socially optimal level of hydrological contamination in DMU 1 is less than that at DMU 2.* [For proof, refer to the Appendix 2B]

Thus, it is observed that in the absence of any regulatory framework, concentration of contaminants in the landscape will be higher than the socially sustainable limits

2.3 Policy options

The objective of the social planner is to force the upstream DMU 1 (the supplier of externality) to change its behaviour because the downstream DMU 2's (the recipient of externality) outcome depends on the behaviour of DMU 1. If DMU 1 is made to produce the socially optimum, then DMU 2's private optimization will produce the socially optimum, too. Baumol and Oates (1988) suggest that, in such cases, economic efficiency requires a pricing asymmetry: a non-zero tax on the supplier of externality and a zero price for the consumption of externality.

Since externality is caused by the upstream DMU 1's agriculture effort in the form of hydrological contamination, the optimal policy would require a tax t_1, on its agricultural effort and tax t_2, on its contamination level. Therefore, optimization would require

$$max\, Q_1 = \int_0^\infty e^{-rt} \left(x_1 - \alpha x_1^2 - h_1^2 - \beta a_1^2 - t_1 x_1 - t_2 h_1\right) \text{ subject to} \tag{12}$$

$$\dot{h}_1 = x_1 - a_1 - (\sigma h_1 + \eta x_1)$$

The optimal taxes are

$$t_1 = (1-\eta)^2|A^s| + \left(\frac{\alpha+(1-\eta)^2\beta}{\beta}\right)\left[|A^s| - \frac{1}{\alpha}\left\{(2-\eta)(1-\eta)\sigma^2 + \sigma(r+\sigma) + (1-\eta)^2\left(\frac{\alpha+(1-\eta)^2\beta}{\alpha\beta}\right) + \frac{\eta}{\beta}\right\}\right] - \sigma(1-\eta)^2\left[\sigma(r+\sigma)^2 + \left(r - \frac{\eta}{1-\eta}\sigma\right)\left(\frac{\alpha+(1-\eta)^2\beta}{\alpha\beta}\right) - \frac{r\eta(1-\eta)}{\alpha}\right] \tag{13}$$

$$t_2 = \frac{(r+\sigma)(1-\eta)\beta}{\alpha+(1-\eta)^2\beta}\left[\frac{\sigma}{|A^s|}\left\{\sigma(r+\sigma)^2 + \left(r - \frac{\eta}{1-\eta}\sigma\right)\left(\frac{\alpha+(1-\eta)^2\beta}{\alpha\beta}\right) - \frac{r\eta(1-\eta)}{\alpha}\right\} - \frac{1}{(1-\eta)^2}\left(\frac{\alpha+(1-\eta)^2\beta}{\beta}\right)\left[1 - \frac{1}{\alpha|A^s|}\left\{(2-\eta)(1-\eta)\sigma^2 + \sigma(r+\sigma) + (1-\eta)^2\left(\frac{\alpha+(1-\eta)^2\beta}{\alpha\beta}\right) + \frac{\eta}{\beta}\right\}\right]\right] - \frac{|A^p|(1-\eta)\beta}{|A^s|[\alpha+(1-\eta)^2\beta]}\left[\sigma(r+\sigma)^2 + \left(r - \frac{\eta}{1-\eta}\sigma\right)\left(\frac{\alpha+(1-\eta)^2\beta}{\alpha\beta}\right) - \frac{r\eta(1-\eta)}{\alpha}\right] \tag{14}$$

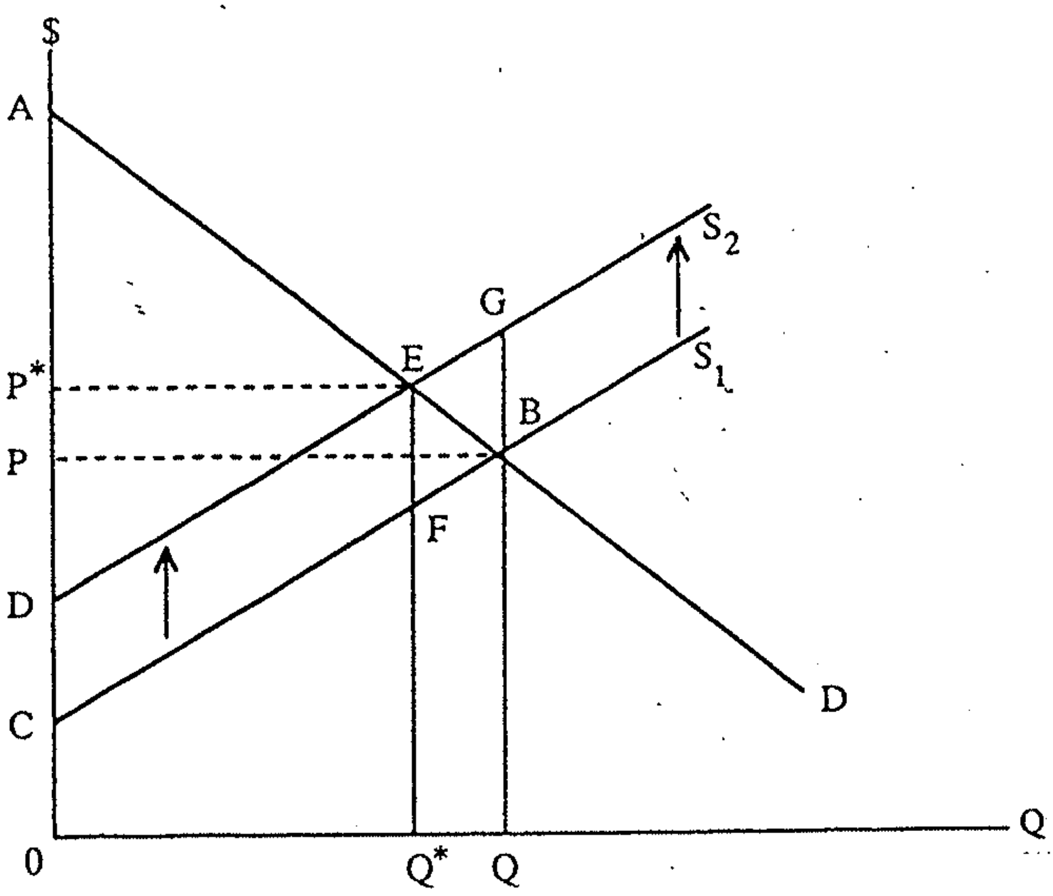
Thus, the effective tax to be applied on the supplier of externality is the sum of the two taxes. This means that when the externality is caused by both increased agricultural effort and intrinsic hydrological contamination, taxing both the effort and contaminants emission may be an optimal agricultural policy.

2.4 Conclusion

The primary purpose of this paper has been to demonstrate why individual optimization of agricultural production activities may lead to undesirable socially optimal outcomes when the upstream farmer does not take into account the costs he or she imposes on the downstream farmer. The scenario is compared with the optimal decision of a social planner and it is concluded that private optimization leads to a higher concentration of contaminants in the landscape. Under the assumption that the externality flow is caused by both the increased agricultural effort and the presence of hydrological contaminants, convergence to the socially optimal steady-state path of hydrological contaminants will require the social planner to apply a composite tax on the supplier of externality. Thus, in the given scenario, taxing not only the flow of contaminants but also the increased effort may be an optimal policy choice.

Appendix 2A

Figure 2.1 Market output, externality, and socially optimal output



Appendix 2B

Proof of Proposition 2:

$$\overline{h}_1^p = \frac{(1-\eta)(r+\sigma)}{2\alpha|A^p|} \text{ and } \overline{h}_2^p = \frac{(r+\sigma)}{2\alpha|A^p|^2}\left[\sigma(r+\sigma)(2-\eta) + \left(\frac{\alpha+(1-\eta)^3\beta}{\alpha\beta}\right)\right]$$

or $\overline{h}_2^p$ can be rearranged as:

$$\overline{h}_2^p = \frac{(r+\sigma)}{2\alpha|A^p|^2}\left[(1-\eta)|A^p| + (1-\eta)\sigma(r+\sigma) + \eta|A^p|\left(\frac{\alpha+(1-\eta)^3\beta}{\alpha\beta}\right)\right]$$

$$\Rightarrow \overline{h}_2^p = \frac{(1-\eta)(r+\sigma)}{2\alpha|A^p|} + \frac{(1-\eta)\sigma(r+\sigma)^2}{2\alpha|A^p|^2} + \frac{\eta(r+\sigma)}{2\alpha|A^p|}\left[1 - \frac{(1-\eta)^2}{\alpha|A^p|}\right]$$

$$\Rightarrow \overline{h}_2^p = \overline{h}_1^p + \frac{(1-\eta)\sigma(r+\sigma)^2}{2\alpha|A^p|^2} + \frac{\eta(r+\sigma)}{2\alpha|A^p|}\left[1 - \frac{(1-\eta)^2}{\alpha|A^p|}\right] \text{ thus,}$$

$$\overline{h}_2^p > \overline{h}_1^p.$$

Similarly, it can be proved that

$$\overline{a}_2^p = \overline{a}_1^p + \frac{1}{2\beta}\left[\frac{1}{\alpha|A^p|^2}\left\{(1-\eta)\sigma(r+\sigma) + \eta|A^p|\left(1 - \frac{(1-\eta)^2}{\alpha|A^p|}\right)\right\}\right] \text{ which gives}$$

$\overline{a}_2^p > \overline{a}_1^p$, and

$$\overline{x}_2^p = \overline{x}_1^p - \frac{1}{2\alpha}\left[\frac{(1-\eta)^2\sigma(r+\sigma)}{\alpha|A^p|^2} + \frac{\eta(1-\eta)}{\alpha|A^p|}\left(1 - \frac{(1-\eta)^2}{\alpha|A^p|}\right)\right], \text{ implying}$$

$$\overline{x}_2^p < \overline{x}_1^p$$

Proof of Proposition 3:

For ($\sigma \neq 0$, $\eta = 0$),

$$\overline{a}_1^s = \frac{1}{2\beta}\left[\frac{1}{\alpha|A^s|}\left\{2\sigma^2 + \sigma(r+\sigma) + \left(\frac{\alpha+\beta}{\alpha\beta}\right)\right\}\right] \text{ and,}$$

$$\overline{a}_2^s = \frac{1}{2\beta}\left[\frac{1}{\alpha|A^s|}\left\{2\sigma(r+\sigma) + \left(\frac{\alpha+\beta}{\alpha\beta}\right)\right\}\right]$$

Set $\overline{a}_1^s = \overline{a}_2^s$

$$\Rightarrow 3\sigma^2 + \sigma r = 2\sigma^2 + 2\sigma r$$

$$\Rightarrow \sigma = r$$

In case of $\sigma > r$, let $\sigma = r + \Delta$ and compare the terms inside the brackets of $\overline{a}_1^s$ and $\overline{a}_2^s$ to give:

$3(r+\Delta)^2 + (r+\Delta)r$	compared with	$2(r+\Delta)^2 + 2(r+\Delta)r$
$3\Delta^2 + 7\text{r}\,\Delta$	compared with	$2\Delta^2 + 6\text{r}\,\Delta$

$\Rightarrow \overline{a}_1^s > \overline{a}_2^s$

And for $\sigma < r$, letting $\sigma = r - \Delta$ gives the following comparison for $\overline{a}_1^s$ and $\overline{a}_2^s$:

$3\Delta^2 - 7\text{r}\,\Delta$	compared to	$2\Delta^2 - 6\text{r}\,\Delta$ or
$(2\Delta^2 - 6\text{r}\,\Delta) - (r-\Delta)\Delta$	compared to	$2\Delta^2 - 6\text{r}\,\Delta$

$\Rightarrow \overline{a}_1^s < \overline{a}_2^s$

Likewise, it can be proved that $\overline{x}_1^s = \overline{x}_2^s$ if $\sigma = r$; $\overline{x}_1^s < \overline{x}_2^s$ if $\sigma > r$ and $\overline{x}_1^s > \overline{x}_2^s$ if $\sigma < r$.

Proof of Proposition 4.

Steady-state solution of equations (11) to (11c) gives:

$$\overline{h}_2^s = \frac{1}{2\alpha|A^s|}\left[(2-\eta)\sigma(r+\sigma)^2 + (r+\sigma)\left(\frac{\alpha+(1-\eta)^2\beta}{\alpha\beta}\right) - \frac{(r+\sigma)\eta(1-\eta)^2}{\alpha}\right] \text{ and}$$

$$\overline{h}_1^s = \frac{1}{2\alpha|A^s|}\left[(1-\eta)\sigma(r+\sigma)^2 + \{r(1-\eta)-\eta\sigma\}\left\{\frac{\alpha+(1-\eta)^2\beta}{\alpha\beta}\right\} - \frac{r\eta(1-\eta)^2}{\alpha}\right]$$

$\overline{h}_2^s$ can be re-arranged as:

$$\overline{h}_2^s = \frac{1}{2\alpha|A^s|}\left[(1-\eta)\sigma(r+\sigma)^2 + \{r(1-\eta)-\eta\sigma\}\left\{\frac{\alpha+(1-\eta)^2\beta}{\alpha\beta}\right\} - \frac{r\eta(1-\eta)^2}{\alpha}\right] + \frac{1}{2\alpha|A^s|}\left[\sigma(r+\sigma)^2 + (r\eta+\sigma)\left(\frac{\alpha+(1-\eta)^2\beta}{\alpha\beta}\right) + \frac{\eta\sigma}{\beta}\right]$$

$$\Rightarrow \overline{h}_2^s = \overline{h}_1^s + \frac{1}{2\alpha|A^s|}\left[\sigma(r+\sigma)^2 + (r\eta+\sigma)\left(\frac{\alpha+(1-\eta)^2\beta}{\alpha\beta}\right) + \frac{\eta\sigma}{\beta}\right]$$

$\Rightarrow \overline{h}_2^s > \overline{h}_1^s$

Chapter 3 Impact of the abolition of the Multi-Fibre Agreement on Pakistan's export of textiles and clothing: An empirical analysis

Abstract

Using the stochastic frontier gravity model and calculating the revealed comparative advantage (RCA) indices, this paper estimates the impact of the abolition of the Multi-Fibre Agreement (MFA) on Pakistan's export of textiles and clothing sub-sectors. Results show that the abolition of the MFA does not have a significant impact on Pakistan's export of textiles sub-sector. Also, the mean-export efficiency of textiles has shown a decreasing trend over time. In contrast, the abolition of the MFA has a significant, positive impact on Pakistan's export of clothing sub-sector with the mean-export efficiency showing an increasing trend over time. Calculation of the revealed comparative advantage reveals that Pakistan has maintained a post-MFA comparative advantage in a wide range of its textiles and clothing products. However, with 70 per cent of Pakistan's total export of textiles and clothing being concentrated in the textiles sector and given the important contribution of the textiles sector to the GDP of Pakistan, declining efficiency in the export of textiles sub-sector will impair the overall economic growth of Pakistan.

JEL Classifications: F14, O14, and O50.

Keywords: Multi-Fibre Agreement, textiles and clothing, stochastic frontier gravity model, revealed comparative advantage, Pakistan.

3.1 Introduction

Textiles and clothing are the only manufacturing sub-sectors, which in digression from the basic principles of then General Agreement on Tariff and Trade (GATT), until recently remained under extensive quota restrictions in the global trading system. The use of quota restraints started with the Long Term Agreement regarding international trade in cotton and textiles (LTA) under the aegis of the GATT in 1962. The LTA was replaced with the Multi-Fibre Agreement (MFA) in 1974 when its scope was extended to materials other than cotton. MFA trade restraints were thereafter renegotiated every 5 years. The Uruguay round of trade negotiations, which resulted in the creation of the World Trade Organization (WTO) in 1995, also led to the conclusion of the Agreement on Textiles and Clothing (ATC). Under the ATC, it was agreed upon by both the importing and exporting countries to progressively phase out the quota system over 10 years, the last quotas being lifted on 1 January 2005.

Trade under the ATC was highly distortionary for two reasons. First, the countries that opted to retain quotas under the ATC namely, the European Union, the United States, Canada and Norway, allocated quotas to trading partners unilaterally. Second, major importers such as the European Union (EU) and the United States (US) sometimes awarded quota-free and tariff-free access to some countries through various preference schemes and regional trade agreements. For example, Mexico for the (US) and Turkey for the EU remained on the preference list (Whalley 2006). In contrast, countries such as Pakistan, India and China were severely restricted by the quota restraints (ILO 2005). This chapter attempts to empirically estimate the impact of the abolition of the MFA on Pakistan's export of textiles and clothing sub-sectors and estimate the export efficiencies of these two sub-sectors.

The industrial sector contributed 23.6 per cent to Pakistan's total GDP and employed 20.3 per cent of the total workforce in 2010. Important industries include textiles and clothing, mining, and information technology. Pakistan has a sound textile industry, as it is one of the major producers of cotton in the world. Textiles and clothing exports contributed over 56 per cent of total exports in the financial year 2010-11, contributed 7.5 per cent to the total GDP and provided employment to about 40 per cent of the labor force involved in manufacturing (Pakistan Economic Survey 2010-11). However, the export profile of Pakistan for the textiles and clothing sub-sectors exhibits two distinct characteristics. First, the exports of Pakistan are concentrated in textiles with the export mix between textiles and clothing remaining at around 70 per cent and 30 per cent respectively from 2003 to 2010. This is due to the fact that Pakistan possesses a large indigenous textiles production capacity. The proportional shares of textile and clothing exports in the total exports of textile and clothing for Pakistan between 2003 and 2007 are shown in Table 3.1.

Table 3.1 World textile and clothing exports of Pakistan, 2003-07

Year	**Total textile exports[a] (million US $)**	**Textile exports as per cent of total textile and clothing exports[b]**	**Total clothing exports (million US $)**	**Clothing exports as per cent of total textile and clothing exports**
2003	5,860	71	2,351	29
2004	6,185	70	2,598	30
2005	7,142	71	2,985	29
2006	7,497	70	3,250	30
2007	7,405	70	3,222	30

Note: [a] Textile figures are in HS revision 2002, and covers chapters 50 to 60 plus chapter 63 of the HS but does not include HS 5001-03, HS 5101-03, HS 5201-03 and HS 5301-02.

[b] Clothing covers chapter 61 to 62 of the HS.

Source: UN COMTRADE database accessed through World Bank's WITS software.

Second, the largest share of Pakistan's export of textiles and clothing is absorbed by the EU and the US. For example, these two destinations accounted for about 55 per cent of the total textiles and clothing exports of Pakistan in 2010. Given a high degree of dependence on the export of textiles and clothing, and on the EU and the US markets, any exogenous shock such as that caused by the abolition of MFA can either further boost Pakistan's exports if it comes as a positive shock, or can equally be adversely affected if the removal of the quota proves to be a negative shock.

There have been very few empirical studies that have examined the impact of the removal of the MFA on Pakistan's textiles and clothing exports. For example, Khan and

Mahmood (1996) estimated that Pakistan would enjoy additional market access of around 62 per cent and 67 per cent respectively for textiles and clothing after the removal of the MFA. Ingco and Winters (1995) argued that the gain to Pakistan after the removal of the MFA would be more than $500 million. Trela and Whalley (1990) worked out their estimates, which showed that Pakistan would gain $0.008 billion.

These predictions, which are based on data pertaining to the MFA periods, indicated that the removal of the MFA would exert a positive shock on Pakistan's textiles and clothing exports. However, the recent performance of Pakistan's textiles and clothing sub-sectors after the removal of the MFA raises doubts about these predictions because of the fact that the textile and clothing sub-sectors have lost their shares in exports, decreasing from 66 per cent in 2004 to 56 per cent in 2010-11, though textile exports from Asia to Africa, Europe and North America increased by 14-20 per cent after the expiry of the MFA (WTO, 2006). Thus, it is imperative to empirically examine the impact of the removal of the MFA on Pakistan's textiles and clothing exports using data from both periods – with and without the MFA. Thus, there are two important questions that are examined in this chapter. The first is whether or not the abolition of the MFA has exerted a positive shock on Pakistan's textiles and clothing exports as predicted by earlier studies. Another important question concerns the decrease in the shares of the textile and clothing sub-sectors in Pakistan's total exports. The issue at hand is whether the factors that are constraining Pakistan's exports growth of textiles and clothing have been increasing or declining over time before and after the removal of the MFA.

3.2 Theoretical framework

It is established in the literature that the gravity model introduced by Tinbergen (1962) and Pöyhönen (1963) explains trade flows between countries very well. Drawing on Newton's law in Physics, the gravity model explains that trade is an increasing function of the respective size of the trading pair and a decreasing function of the distance between them. In this basic form, national gross domestic product proxies the size of a country, while distance is a proxy for the transportation cost between the trading pairs. Linnemann (1966) provided a further extension to the gravity model by including population and complementarity as additional trade explanators. However, the first theoretical contribution came from Anderson (1979). He provided the gravity model with a theoretical underpinning and derived the gravity equation from an expenditure system based on homothetic and Armington preferences of traded goods.[2] On the same assumption of Armington preferences, Bergstand (1985) derived the gravity model as a partial equilibrium subset of a general equilibrium model. Helpman (1987) used imperfect competition for his derivation of the gravity model whereas Deardorff (1995) justified the model from the standpoint of standard trade theories.

The gravity model framework has been extended to explain various research problems: Arnon and Weinblatt (1998) used it to test Linder's hypothesis,[3] Frankel et al. (1997) studied the dynamics of trading blocs using gravity model, Rose (2000) explained the impact of monetary integration on trade flows by including a common currency as a trade explanatory, and Nilsson (2000), Egger (2002), Rahman (2003) and Kalirajan (2007) among others have used the gravity model for estimating the trade potentials of different countries. This latter approach is more suitable in answering the objective questions of this chapter and is therefore adopted in this study.

The choice of the estimation technique depends on the nature of the modeling framework and the availability of data. Though the gravity model has often been estimated using cross-section data (Batra 2004: Ram & Prasad 2007), use of panel data has an evident advantage over cross sectional analysis for two main reasons. First, it is possible to analyse the relationship among variables over time. Second, panel data estimation makes it possible to account for the individual effects of the trading partners that are unobserved (Martinez-Zarzoso & Nowak-Lehman 2003). If individual effects are omitted, the OLS estimators will be biased, if these individual affects happen to be correlated with the explanators. Therefore, Cheng and Wall (2005) suggested the fixed effects panel data estimation to control for variables that do not change with time such as distance. To find an estimate for the time-invarying variables, Coulibaly (2004) and Martinez-Zarzoso and Nowak-Lehman (2003) adopted a two-stage estimation technique: in the first stage they regressed the dependent variable on all time-varying variables only, and in the second stage the estimates for country pair fixed effects were regressed on all time-invariant variables that have been dropped from the first stage regression.

However, estimating the country pair individual effects using dummy variables entails statistical and computational complications. Using a large number of dummy variables

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[2] Armington preferences mean product differentiation on the basis of country of origin

[3] Linder (1961) suggested that same sized countries (having similar income levels) will trade more.

will cost the regression in terms of losing 'degrees of freedom.' Also, the estimates, though unbiased, will be inconsistent because there will be no convergence of the individual effects to a single value (Wooldridge 2009). Drawing on Anderson (1979), the gravity equation in its basic form is defined as

$$\mathrm{M}_{ijk} = \alpha_k \mathrm{Y}_i^{\beta_k} \mathrm{Y}_j^{\gamma_k} \mathrm{N}_i^{\xi_k} \mathrm{N}_j^{\psi_k} \mathrm{d}_{ij}^{\mu_k} \mathrm{U}_{ijk} \quad (1)$$

where M_{ijk} denotes the trade flow of commodity *k* from country *i* to country *j*, Y_i and Y_j represent incomes of country *i* and *j* and N_i and N_j are their respective populations. U_{ijk} is an error term such that E(*ln* U_{ijk})=0 and its distribution is log normal. The gravity equation derived by Anderson from an expenditure system is given on page 113 in Anderson (1979) as

$$\mathrm{M}_{ij} = \frac{m_i \phi_i Y_i \phi_j Y_j}{\sum_j \phi_j Y_j} \cdot \frac{1}{f(d_{ij})} \cdot \left[\sum_j \frac{\phi_j Y_j}{\sum_j \phi_j Y_j} \cdot \frac{1}{f(d_{ij})}\right]^{-1} U_{ij} \quad (2)$$

where ϕ_j is the share of expenditure in total expenditure of importing country *j* on all traded goods and likewise ϕ_i is the share of traded goods expenditure in total expenditure of country *i* when country *i* is the consuming country. Anderson (1979) assumed that both *m* and ϕ depends on income and population and he assigned log linear form to the terms $\left(m_i = m(\mathrm{Y}_i, \mathrm{N}_i\right) = k_m \mathrm{Y}_i^{m_y} \mathrm{N}_i^{m_n}$ and $\phi_i = F(\mathrm{Y}_i, \mathrm{N}_i) = k_\phi \mathrm{Y}_i^{\phi_y} \mathrm{N}_i^{\phi_n})$. Here m_i is a capital account scale factor to account for balance of payments disequilibrium. Furthermore, transaction costs $(\tau_j = f(d_{ij}))$ are assumed to be an increasing function of distance. This transformation reduces the gravity equation (2) into

$$M_{ij} = \frac{k_m k_\phi^2 Y_i^{m_y+\phi_y+1} N_i^{m_n+\phi_n} Y_j^{\phi_y+1} N_j^{\phi_n}}{\sum_j k_\phi Y_j^{\phi_y+1} N_j^{\phi_n}} \cdot \frac{1}{f(d_{ij})} \cdot \left[\sum_j \frac{k_\phi Y_j^{\phi_y+1} N_j^{\phi_n}}{\sum_j k_\phi Y_j^{\phi_y+1} N_j^{\phi_n}} \cdot \frac{1}{f(d_{ij})}\right]^{-1} U_{ij} \quad (3)$$

There are two main differences between equation (3) and the standard gravity equation presented in equation (1). First, in equation (3), $1/f(d_{ij})$ is not a log linear function, though it is not uncommon to use it in this form in empirical estimation. Second, the term in square brackets is not found in equation (1). This term represents the 'economic distance' between country *i* and *j* (Anderson 1979, p.113). Omission of this economic distance term has two consequences. First, it will disrupt the log normal distribution of the error term affecting the normality assumption of the errors. Second, this misspecification will lead to heteroskedastic error terms leading to inconsistent and biased estimates (Matyas 1997). Moreover, it is difficult to identify the structure of heteroskedasticity due to the unobservable effects specific to each observation. As discussed in Kalirajan (2008), in situations where the source of heteroskedasticity is unknown, one approach to estimate the gravity model efficiently incorporating the heteroskedastic information is to use the estimation technique used in the stochastic production frontier approach popularized by Aigner *et al.* (1977) and Van Den Broeck (1977)[4]. This approach is followed in this paper.

3.3 Methodology

Drawing on the panel data stochastic frontier approach discussed by Battese and Coelli (1992), the gravity model for exports is represented in log linear form as

$$\ln(\mathrm{X}_{ijt}) = \ln\left(f\left(\mathrm{Z}_{it};\beta\right)\right) - u_{it} + v_{it} \qquad (4)$$

where X_{ijt} corresponds to actual exports from country *i* to country *j* at time period t. The function $f\left(\mathrm{Z}_{it};\beta\right)$ represents the determinants of bilateral trade (Z_{it}) and β is a vector of unknown parameters. v_{it} is a two-sided error term, independently and identically distributed $\mathrm{N}(0,\sigma_v^2)$. It captures the effect of omitted variables, any functional form deviations, and any measurement errors in variables. u_{it}, which is heteroskedastic, represents the whole impact of unobservable country-specific characteristics that constrain actual exports from further significant growth due to various inefficient infrastructural and institutional factors. u_{it} can therefore be termed as the combined effects of 'behind the border' constraints, and is assumed to be non-negative truncations of $\mathrm{N}(\mu,\sigma_u^2)$ distribution.

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[4] Feenstra (2002) used price differences between trading partners in his specification of the gravity model.
Since McCallum (1995) many empirical papers have used 'remoteness' variables, generally defined by $\sum_{m\neq j} d_{im}/y_m$, where *d* is distance and *y* is GDP and the whole term represents the weighted average distance of country *i* from all its trading partners, except the particular partner j. Anderson and Wincoop (2003) criticize these remoteness variables and suggest another multilateral resistance term. However, these solutions are either not based on the basic theory of the gravity model or cannot fully capture the inherent bias in the empirical estimation. These also give biased results by not taking care of heteroskedasticity and non-normality of the error term.

Battese and Coelli (1992) assumed the effects of country-specific characteristics to be time-varying and followed an exponential specification that incorporates unbalanced panels also:[5]

$$u_{it} = \eta_{it} u_i = \left\{ \exp\left[-\eta(\text{t-T})\right]\right\} u_i, \quad \text{t} \in \Im(i); i = 1, 2, \ldots \text{N} \tag{5}$$

Here, η is an unknown parameter and determines whether the non-negative individual country effects u_{it}, which are 'behind the border' constraints, decrease (η>0), remain constant (η=0) or increase with time (η<0). Thus, 'behind the border' constraints tend to increase over time when η is positive, and decrease if η is negative. Estimates of βs, η, μ and σ_u^2 can be obtained through the maximum likelihood estimation using the computer software FRONTIER 4.1 by Coelli (1996).

3.4 Data and empirical specification of the model

As the objective is to examine the impact of the removal of the MFA on Pakistan's exports of textiles and clothing, it is important that the influence of the recent 2008 global financial crisis is not incorporated into the analysis. This can be achieved by isolating the period of the global financial crisis from other periods through introduction of dummy variables in the gravity model. Alternatively, the analysis can be carried out using Pakistan's export data from 2003 (the recent MFA period) to 2007 (pre-global financial crisis period), which is followed in the present study. The sample consists of 166 countries for a period of five years from 2003 to 2007. However, the panel is unbalanced and the sample consists of a total of 823 observations. Data for the exports of textiles and clothing is based on the HS-2002 classification and is obtained from the UN COMTRADE database through the World Bank's World Integrated Trade Solutions (WITS) software. Under the Harmonized Commodity Description and Coding System (HS), textiles and clothing are classified under Section XI. Chapters 50 to 60 of this section deal with textiles and chapters 61 to 63 categorize clothing. However, section XI overestimates textiles to the extent that it includes certain agricultural products: raw silk and its waste, wool and its waste, cotton and cotton waste, and flax (UNCTAD 2008). The International Textiles and Clothing Bureau also excludes these products from the categorization of textiles (ITCB 2008). Thus, textiles in this chapter refers to products covered by the HS chapters 50 through 60 plus 63, but excludes agricultural raw

[5] See Cornwell et al. (1990) and Kumbhakar (1990) for alternative specifications.

materials under HS 5001-03, 5101-03, 5201-03 and 5301-02. Clothing is covered by chapters 61 and 62.

Data on Gross Domestic Product (GDP), population, official exchange rate and consumer price indices are taken from World Development Indicators (WDI) of The World Bank. Consumer price indices are based on the year 2000 as the base year. Data on population and GDP of some countries is missing in WDI and is, therefore, taken from the UNCTAD Handbook of Statistics, 2008. Distances are taken from Centre d'études prospectives et d'informations internationales (CEPII)[6] and are calculated on the basis of great circle distance. Following Harberger (2004), real exchange rates are calculated using the conversion, $\text{real exchange rate} = \text{nominal exchange rate}/\text{CPI}$. This represents the CPI basket needed to buy a nominal dollar of foreign exchange.[7]

The empirical model used for estimating Pakistan's exports of textiles and clothing commodities is given by

$$ln\left(\mathrm{X}_{Pak\ j,t}\right) = \beta_0 + \beta_1 ln\left(\mathrm{GDP}_{j,t}\right) + \beta_2 ln\left(\mathrm{Pop}_{j,t}\right) + \beta_3 ln\left(\mathrm{GDP}_{Pak,t}\right) + \beta_4 ln\left(\mathrm{Pop}_{Pak,t}\right) + \beta_5 ln(\mathrm{dis}) + \beta_6(\mathrm{rer}_t) + \beta_7 \mathrm{dEU25} + \beta_8 \mathrm{MFA} + v_{j,t} - u_{j,t} \tag{6}$$

The variables in this model are defined as

$\mathrm{X}_{Pak\ j,t}$ is the volume of exports of textiles (clothing) from Pakistan to country *j* at period t, measured in millions of US dollars.

$\mathrm{GDP}_{j,t}$ is the GDP of partner country *j* at period t, in current US dollars.

$\mathrm{Pop}_{j,t}$ is the total population, in millions, of the trading partner *j* at period t.

$\mathrm{GDP}_{Pak,t}$ is the GDP of Pakistan at time t, measured in current US dollars.

$\mathrm{Pop}_{Pak,t}$ is the total population, in millions, of Pakistan at time t.

dis is the distance, measured in kilometers, between Pakistan and its respective trading partner *j*.

rer_t is the real exchange rate of importing country *j* at period t.

[6] This data is taken from <http://www.cepii.fr/anlaisgraph/bdd/distances.htm> viewed 10 July 2012.

[7] The exact formula for the real exchange rate is: $rer = E\mathrm{P}^*/\mathrm{P}_d$ where P^* denotes the world price, P_d represents the domestic price and E is the nominal exchange rate. Harberger (2004) argues that for short run problems the definition E/P_d is adequate for real exchange rate analysis. Also, he favours CPI or GDP deflator as domestic price variables.

dEU25 is a dummy variable which take the value one if the importing country is a member of EU25 at time t.

dMFA is a dummy variable which takes the value zero for all time periods when the Multi-Fibre Agreement was effective (2003 and 2004) and taking the value of one for the years when it stood abolished (2005, 2006 and 2007).

$v_{j,t}$ is the double-sided random error distributed $N(0,\sigma_v^2)$ at period t.

$u_{j,t}$ is the one-sided error term referring to country-specific characteristics, which is termed 'behind the border' constraints and is independently and identically distributed with the truncation of $N(\mu,\sigma_u^2)$ distribution.

A summary of the data used in the estimation of the frontier gravity model (6) is given in Table 3.2. It is observed that there are zero values both for export of textiles and clothing in the sample. As long as zeros are randomly distributed, they can be discarded from the sample (Westerlund &Wilhelmsson 2006). However, zeros are not usually random and ignoring them will lead to bias in estimation. Thus, following Pusterla (2007) and Moktan (2008), all missing values for exports are assumed to be equal to a very small number; 1 is added to the export value $(X_{Pak,j})$ so that with log transformation $\log(1+X_{Pak,j})=0$ when $X_{pak,j}=0$. This is not an unreasonable assumption to make because the World Bank's WITS software reports export data to the extent of a unit of a dollar.

Table 3.2 Summary statistics for variables in stochastic gravity model.[a]

Variable	Sample Mean	Sample Standard Deviation	Minimum Value	Maximum Value
Export of textiles (million US $)	41.23798	159.5853	0	2223.165
Export of clothing (million US $)	17.49711	119.2918	0	1740.706
GDP of trading partner (million US $)	2726979	1096587	4.082665	1.38e+07
Population of trading partner (millions)	37.45105	135.6705	.0712128	1318.31
GDP of Pakistan (million US $)	112149.4	21023.29	83244.8	142893
Population of Pakistan (millions)	155.5432	4.945849	148.4388	162.4814
Distance in kilometers	7009.419	4046.483	805.9722	16334.9
Real exchange rate (LCU/$)	384.4488	1338.274	.0095113	14534.12

Note: [a] The data consists of 823 observations collected for 166 trading partners of Pakistan from 2003-07. The panel is unbalances so that 7 observations are missing

3.5 Analysis of results

Assuming a full normal distribution with a zero mean and a constant variance for v_{jt} and a truncated normal distribution for u_{jt}, all the parameters appearing in the stochastic frontier model (10) are estimated using the maximum likelihood estimation (MLE). In addition to nine *β*-parameters, these include four additional parameters (γ, η, μ and σ^2) associated with the distribution of v_{jt} and u_{jt}. In order to arrive at the correct specification of the model, five basic models are estimated for the export of textiles and clothing separately. These models are:

Model 1.0 incorporates all the parameters (the ratio of the variance due to country-specific characteristics to total variance of exports γ, the coefficient of time varying 'behind the border' constraints impact η, and truncated normal distribution for u_i);

Model 1.1 assumes, $\mu = 0$ (this means half normal distribution for u_i);

Model 1.2 assumes, $\eta = 0$ (implying time invariant 'behind the border' constraints impacts);

Model 1.3 assumes, $\mu = \eta = 0$; and

Model 1.4 assumes, $\gamma = \mu = \eta = 0$.

Results of the estimation are reported in Table 3.4 and Table 3.6 of the Appendix 3A. The above hypotheses tests are obtained using likelihood ratio (LR) test statistics. The test statistic is $LR = -2\lfloor \log L_{H_o} - \log L_{Ha} \rfloor \sim \chi^2(J)$ (11)

where $\log L_{H_o}$ and $\log L_{Ha}$ denote the likelihood values for the model under null and alternative hypotheses respectively and J is the number of restrictions. The critical values for the LR test statistic are obtained from a mixed χ^2 distribution as reported by Kodde and Palm (1986). The test hypotheses relating to distributional assumptions along with test statistics are reported in Table 3.5 and Table 3.7 of the Appendix 3A.

Based on the LR test, it may be inferred that the model explaining textile exports has time-varying 'behind the border' constraints with truncated normal distribution. Similarly, for the model explaining clothing exports, half normal distribution for 'behind the border' constraints along with time varying characteristics is accepted as the correct specification. MLE estimates for the parameters of the two models are presented in Table 3.3.

Table 3.3 MLE estimates for export of textiles and clothing models[a,b]

Variable	Parameter	MLE estimates	
		Textiles	**Clothing**
Constant	β_0	191.19*	530.22*
		(154.06)	(304.93)
log(GDP$_j$)	β_1	0.802*	1.10*
		(11.93)	(10.71)
log(Pop$_j$)	β_2	0.246*	0.15
		(3.03)	(1.18)
log(GDP$_{Pak}$)	β_3	10.91*	19.66*
		(11.15)	(9.59)
log (Pop$_{Pak}$)	β_4	-63.85*	-151.70*
		(-30.02)	(-34.26)
log(dis)	β_5	-0.2206	-0.548**
		(-1.48)	(-2.36)
log(rer)	β_6	-0.079**	-0.250*
		(-2.046)	(-4.14)
dEU25	β_7	0.033	1.32*
		(0.115)	(2.98)
dMFA	β_8	0.301	0.883**
		(1.10)	(2.003)
	$\sigma^2 = \sigma_u^2 + \sigma_v^2$	40.38*	13.9*
		(4.29)	(10.74)
	$\gamma = \sigma_u^2 / \sigma^2$	0.883*	0.248*
		(24.07)	(3.71)
	μ	-11.94*	0
		(-2.69)	
	η	-0.235*	0.228*
		(-5.43)	(4.26)
	Log likelihood	-1892.305	-2218.044

Notes: [a]Values in parenthesis are the t-ratios.

[b] For the parameters' estimates, * represents significance at the 1 percent level, ** refers to significance at the 5 percent level and *** refers to significance at the 10 percent level.

For the textiles sub-sector model the coefficient estimates are significant at least at the 5 per cent level and their signs are as theory would predict. The signs for GDP of the partner country and GDP of Pakistan are positive, indicating that export flows of textiles increase with the size of both trading partners. The sign for the population of partner country is positive implying that an increased demand in the importing country increases exports of textiles commodities from Pakistan. However, the effect of an increase in Pakistan's population is a corresponding increase in domestic demand for textiles commodities and, therefore a decrease in exports. The sign of distance is negative but not significant. Moreover, Pakistan's textiles exports are significantly responsive to the importing countries' real exchange rate, though with a low elasticity. The elasticity of textile exports bears a negative sign. This means that depreciation of the domestic currency of the importing country makes imports expensive and this decreases Pakistan's textiles exports. The dummies for the EU and the MFA are positive but not significant. The EU dummy has been included in regression because before the abolition of the MFA, the EU was one of the high restraining regions in terms of textiles and clothing imports from developing countries. The other countries were the US, Norway and Canada. However, the results indicate that the abolition of the MFA does not have any impact on Pakistan's exports of textiles.

This result is not surprising. Referring again to Table 3.1, it is evident that the share of textiles in Pakistan's total textiles and clothing exports stagnated at around 70 per cent from 2004 to 2007. And for the same period, textiles exports to the EU and the US as a proportion of total textiles exports also remained stagnant at around 30 per cent and 25 per cent respectively. One reason for Pakistan's export of textiles to the EU being stagnant could be explained by the imposition of 13.1 per cent anti-dumping duty on Pakistan's export of bed linen (HS-6302) by the EU (Council Regulation 2004).

Other key results from the regression include the *gamma* coefficient (γ) and the *eta* coefficient (η). The γ-coefficient indicates how much of the total variation in exports is due to country-specific characteristics. For textiles exports, this estimate is 0.88 and is significant at the 1 per cent level, which implies that 88 per cent of total variation in textiles exports is explained by 'behind the border' constraints in Pakistan. Commensurate with this result is the sign of η- coefficient, which is negative and significant. This means that the combined effect of 'behind the border' constraints of Pakistan's textiles exports has been decreasing over time. This implies that Pakistan has been improving its infrastructure and institutional framework to promote textiles exports from Pakistan.

For clothing exports, all the variables bear the same signs as in the case of textiles exports. However, there are few differences between the two results: the population of the importing country is not significant, and the dummies for the EU and the MFA are both positive and significant. This means that, *ceteris paribus*, Pakistan's export of clothing increases by 140 per cent ($100\times$[exp(0.883)-1]) with the abolition of the MFA and increases by 270 per cent ($100\times$[exp(1.32)-1]) when imported by EU member countries. It is also evident from the data that Pakistan's clothing exports to the EU increased from 37 per cent in 2003 to 40 per cent in 2007, and to the US, the increase was from 46 per cent to 52 percent during the same period. The results also indicate that the value of the γ-coefficient is low (0.248), but significant at the 1 percent level. Thus, the implication is that only about 25 percent of total variation in clothing exports was explained by 'behind the border' constraints in Pakistan. Nevertheless, a positive and significant value for the η-coefficient indicates that, unlike textiles, the combined impact of 'behind the border' constraints on Pakistan's clothing exports have been increasing over time. This is alarming, as it indicates that Pakistan's clothing exports' share in total exports has been declining. The above analyses provide information about the impact of 'behind the border' constraints in Pakistan on its textiles and clothing exports. The results show that Pakistan needs to eliminate 'behind the border' constraints to improve its textiles and clothing exports. Another interesting problem relates to whether Pakistan's clothing and textiles market shares have been increasing or decreasing globally.

Market share is not a good indicator of export competitiveness because a large market share does not necessarily imply a comparative advantage. A better index is the revealed comparative advantage (RCA) index. This index gives the share of country *i*'s export of commodity *k* in its total exports relative to the corresponding share of commodity *k* in world exports. Following Balassa (1985), RCAs for Pakistan's export of textiles and clothing commodities at the HS 4-digit level were calculated separately for the global market and the EU market (Appendix 3B provides the methodology). The index is calculated for three time periods: 2003, 2005 and 2007 and the changing pattern of comparative advantage is analysed. A shift (positive) from comparative disadvantage to comparative advantage is said to have occurred if the RCA for a given product in the previous year was less than one, and in the latter year is greater than one. Likewise, if the RCA drops from a value greater than one to a value lower than one, there is a shift from comparative advantage to comparative disadvantage.

Table 3.8 of Appendix 3B presents textiles and clothing commodities that display an RCA greater than one and the corresponding shifts in RCAs during three periods 2003-05, 2005-07 and 2003-07. These results indicate that Pakistan has been able to maintain its comparative advantage in most of the products, gaining comparative advantage in additional products and losing it in a few commodities. In the global market, Pakistan lost its comparative advantage in knitted fabrics, woven fabrics and carpets from 2005 to 2007 (2005 is taken as the cut-off period because the MFA was abolished as at 01 January 2005). In the clothing sector, Pakistan lost its global comparative advantage in garments, shawls and women's wear such as overcoats and cloaks during the same period. However, for all these clothing products, Pakistan retained its comparative advantage in the EU market. 'Made-ups' of woven fabrics and yarn (HS 6308), for which Pakistan lost its comparative advantage in the global market, became a new entrant in the EU market, whereas it retained its comparative advantage for carpets (HS 5702) in the EU market.

3.6 Conclusions

This chapter has estimated the impact of the abolition of the MFA on Pakistan's exports of textiles and clothing using a stochastic frontier gravity model taking into account the existing 'behind the border' constraints to increase exports. A stochastic frontier gravity model with error decomposition into the impact of 'behind the border' constraints (u_{it}) and conventional 'statistical errors' (v_{it}) is used for the estimation of the gravity model. Results show that the abolition of the MFA has not had a significant impact on Pakistan's export of textiles. Also, the impact of the 'behind the border' constraints on textiles exports has been decreasing over time, which is a good sign of Pakistan's economic reform process. In contrast, the abolition of the MFA has a significantly positive impact on Pakistan's export of clothing, but the impact of the 'behind the border' constraints on clothing exports has been increasing over time, which is not an encouraging sign for Pakistan's economic reform process. Nevertheless, the calculation of revealed comparative advantage reveals that Pakistan has maintained a post-MFA comparative advantage in a wide range of its textiles and clothing sub-products.

Thus, with 70 per cent of Pakistan's total exports of textiles and clothing being concentrated in the textiles sector and given the importance of the textiles sector in the GDP of Pakistan, this study emphasizes that it is still possible to improve its growth further by eliminating the existing 'behind the border' constraints such as infrastructure and institutional limitations. It will be interesting to examine what types of infrastructure and institutional improvements are needed. However, due to data limitations, such analysis could not be undertaken in this study. In the context of this study, the following recent statement of the State Bank of Pakistan is worth noting: "It is, therefore, safe to conclude that the textile sector in Pakistan is going to face stiffer competition from neighbouring economies and it would become difficult for it to survive if there is no modernization in production process and new marketing strategies are not adopted" (State Bank of Pakistan, 2011, p.122).

Appendix 3A

Table 3.4 Maximum likelihood estimates for the parameters of the stochastic frontier gravity model for textiles exports [a,b]

		MLE Estimates				
Variable	**Parameter**	**Model 1.0**	**Model 1.1**	**Model 1.2**	**Model 1.3**	**Model 1.4**
Constant	β_0	191.19*	-10.48	194.65*	194.79*	193.02
log(GDP_j)	β_1	0.802*	0.813*	0.822*	0.829*	0.851*
log(Pop_j)	β_2	0.246*	0.241*	0.255*	0.257*	0.271*
log(GDP_{Pak})	β_3	10.91*	1.62	6.86*	6.69*	6.61
log (Pop_{Pak})	β_4	-63.85*	-2.41	-55.35**	-54.93*	-54.75
log(dis)	β_5	-0.2206	-0.245	-0.181	-0.193	-0.211
log(rer)	β_6	-0.079**	-0.086**	-0.092**	-0.10**	-0.089**
dEU25	β_7	0.033	0.014	0.027	0.022	0.342
dMFA	β_8	0.301	-0.011	0.343***	0.369	0.373
	$\sigma^2 = \sigma_u^2 + \sigma_v^2$	40.38*	15.86*	20.06*	10.01*	7.04
	$\gamma = \sigma_u^2 / \sigma^2$	0.883*	0.70*	0.757*	0.509*	
	μ	-11.94*	0	-7.79*	0	
	η	-0.235*	-0.233*	0	0	
	Log likelihood	-1892.305	-1897.631	-1901.340	-1906.074	-1966.314

Notes: [a]Values in parenthesis are the t-ratios.

[b] For the parameters' estimates, * represents significance at 1 percent level, ** refers to significance at 5 percent level, and *** refers to significance at 10 percent level.

Table 3.5 Hypotheses tests results for distributional assumptions: textiles exports

Assumptions	Null hypothesis H_0	χ^2-statistics	$\chi^2_{0.95}$ critical[a]	Decision
Model 1.0	$\gamma = \mu = \eta = 0$	148.018	7.045	Reject H_0
Model 1.0	$\mu = \eta = 0$	27.538	5.138	Reject H_0
Model 1.0	$\mu = 0$	10.652	2.706	Reject H_0
Model 1.0	$\eta = 0$	18.07	2.706	Reject H_0
Model 1.1 ($\mu = 0$)	$\gamma = \eta = 0$	137.366	5.138	Reject H_0
Model 1.1 ($\mu = 0$)	$\eta = 0$	16.88	2.706	Reject H_0

Note: [a] The critical values for null hypothesis are obtained from Table 1 of Kodde and Palm (1986)

Table 3.6 Maximum likelihood estimates for the parameters of the stochastic frontier gravity model for clothing exports[a,b]

		MLE Estimates				
Variable	**Parameter**	**Model 1.0**	**Model 1.1**	**Model 1.2**	**Model 1.3**	**Model 1.4**
Constant	β_0	529.79*	530.22*	526.35*	526.37*	523.89
log(GDP$_j$)	β_1	1.09*	1.10*	1.138*	1.15*	1.28*
log(Pop$_j$)	β_2	0.149	0.15	0.101	0.102	0.075
log(GDP$_{Pak}$)	β_3	20.24*	19.66*	25.08*	25.06*	24.96
log (Pop$_{Pak}$)	β_4	-152.92*	-151.70*	-163.37*	-163.35*	-163.77
log(dis)	β_5	-0.575**	-0.548**	-0.642*	-0.612*	-0.382
log(rer)	β_6	-0.244*	-0.250*	-0.250*	-0.258*	-0.261**
dEU25	β_7	1.31*	1.32*	1.30*	1.31*	1.34
dMFA	β_8	0.915**	0.883**	1.17*	1.17*	1.18
	$\sigma^2 = \sigma_u^2 + \sigma_v^2$	17.06**	13.9*	30.07	20.32*	14.49
	$\gamma = \sigma_u^2 / \sigma^2$	0.382	0.248*	0.634**	0.46*	
	μ	-2.53	0	-5.09	0	
	η	0.226*	0.228*	0	0	
	Log likelihood	-2217.749	-2218.044	-2227.039	-2227.322	-2263.393

Notes: [a] Values in parenthesis are the t-ratios.

[b] For the parameters' estimates, * represents significance at 1 percent level, ** refers to significance at 5 percent level, and *** refers to significance at 10 percent level.

Table 3.7 Hypotheses tests for distributional assumptions: clothing exports

Assumptions	**Null hypothesis** H_0	χ^2 **-statistics**	$\chi^2_{0.95}$ **critical value** [a]	**Decision**
Model 1.0	$\gamma = \mu = \eta = 0$	91.28	7.045	Reject H_0
Model 1.0	$\mu = \eta = 0$	19.146	5.138	Reject H_0
Model 1.0	$\mu = 0$	0.59	2.706	Accept H_0
Model 1.0	$\eta = 0$	17.99	2.706	Reject H_0
Model 1.1 ($\mu = 0$)	$\gamma = \eta = 0$	90.69	5.138	Reject H_0
Model 1.1 ($\mu = 0$)	$\eta = 0$	18.56	2.706	Reject H_0

Note: [a] The critical values for null hypothesis are obtained from Table 1 of Kodde and Palm (1986)

Appendix 3B

RCA on global basis is calculated as:

$RCA_{x,k,Pak} = (X_{k,Pak}/X_{Pak})/(X_{kw}/X_{w})$ where:

$X_{k,Pak}$ = Value of Pakistan's export of commodity *k*.

X_{Pak} = Value of Pakistan' export of all commodities

X_{kw} = Value of world export of commodity *k*.

X_{w} = Value of total world export.

RCA in the EU market is calculated as:

$RCA_{x,k,Pak} = (M_{k,Pak}/M_{Pak})/(M_{kw}/M_{w})$ where:

$M_{k,Pak}$ = Value of EU's import of commodity *k* from Pakistan.

M_{Pak} = Value of EU's total import of all commodities from Pakistan.

M_{kw} = Value of EU import of commodity *k* from the world.

M_{w} = Value of total EU imports for the world

Table 3.8 Shifts in static RCAs in the global and the EU market for Pakistan's export of textiles and clothing, 2003-07

Level	Index	RCA retained		Negative shift		Positive shift	
		Textiles	Clothing	Textiles	Clothing	Textiles	Clothing
EU25	RCA (2003-05)	5204,5205,5206,5208,5209,5210,5211,5212,5513,5514,5515,5607,5701,5702,5705,5801,5802,5808,5810,5903,5907,6003,6301,6302,6303,,6304,6305,6306,6307,6310	6101,6102,6103,6104,6105,6106,6107,6108,6109,6110,6111,6112,6113,6114,6115,6116,6201,6202,6203,6204,6205,6206,6207,6208,6209,6210,6211,6213,6214,6216,6217	5509,5803,5809		5007,5303,5310,5503,5516,5606,5806,5807,6306	
	RCA (2005-07)	5204,5205,5206,5208,5209,5210,5211,5212,5303,5310,5407,5510,5512,5513,5514,5515,5516,5607,5701,5702,5705,5801,5802,5806,5807,5808,5810,5907,6003,6301,6302,6303,6304,6305,6306,6307,6310	6101,6102,6103,6104,6105,6106,6107,6108,6109,6110,6111,6112,6113,6114,6115,6116,6117,6201,6202,6203,6204,6205,6207,6208,6209,6210,6211,6213,6214,6216,6217	5503,5505,5606,5903	6206	5207,5308,5311,5509,5511,5805,5809,5908,6308	
	RCA (2003-07)	5204,5205,5206,5208,5209,5210,5211,5212,5407,5509,5512,5513,5514,5515,5607,570	6101,6102,6103,6104,6105,6106,6107,6108,6109,6110,6111,6112,6113,6114,6115,	5803,5903	6206	5207,5303 5308,5310,5311,5405,	6117

		1,5702,5705,5801,5802,5808,5809,5810,5907,6003,6301,6302,6303,6304,6305,6307,6310	6116,6201,6202,6203,6204,6205,6207,6208,6209,6210,6211,6213,6214,6216,6217			5510,5511,5516,5805,5806,5807,5908,6308	
Global	RCA (2003-05)	5109,5204,5205,5206,5208,5209,5210,5211,5212,5303,5310,5407,5503,5506,5509,5513,5601,5701,5802,5803,5804,5807,6006,6301,6302,6303,6304,6305,6306,6307,6308,6310	6101,6103,6104,6105,6106,6107,6108,6109,6111,6112,6114,6115,6116,6117,6203,6204,6205,6206,6207,6208,6209,6211,6213,6214,6216	5402,5507,5511,5806,		5207,5305,5408,5514,5607,5702,5901,5907,5908,6001,6002,6003,6005	6102,6113,6210
	RCA (2005-07)	5109,5204,5205,5206,5207,5208,5209,5210,5211,5212,5303,5310,5407,5408,5503,5506,5509,5513,5514,5601,5607,5701,5802,5807,5901,5907,5908,6003,6005,6006,6301,6302,6303,6304,6305,6306,6307,6310	6101,6103,6104,6105,6106,6107,6108,6109,6111,6112,6114,6115,6116,6117,6203,6204,6205,6206,6207,6208,6209,6211,6213,6216	5305,5702,5803,5804,6001,6002 6308	6102,6113 6210,6214	5507,5510,5511,5512,5516,5605,5811	6110
	RCA (2003-07)	5109,5204,5205,5206,5208,5209,5210,5211,5212,5303,5310,5407,5503,5506,5507,	6101,6103,6104,6105,6106,6107,6108,6109,6111,6112,6114,6115,6116,6117,6203,	5402,5803,5804,5806,6308	6214	5207,5408,5510,5512,5514,5516,	6110,

5509,5511,5513,5601,5701,5802,5807,6006,6301,6302,6303,6304,6305,6306,6307,6310	6204,6205,6206,6207,6208,6209,6211,6213,6216	5605,5607,5811,5901,5907,5908 6003,6005

Chapter 4 The economic impact of international remittances on household consumption and investment in Pakistan

Abstract

This paper uses nationally representative household income and expenditure survey data for Pakistan to investigate how the receipt of international remittances affect the average and marginal spending behaviour of households on five different categories of goods: food, education, health, non-durables and durables. Two findings emerge. First, expenditure share on food for households that receive remittances would have been more if the households had not been receiving remittances. Similarly, less spending on the other four categories of education, health, non-durables and durables is predicted for remittances-receiving households had they not been receiving remittances. Second, households that receive remittances spend less at the margin on food and durables and more on education, health and non-durables. At the mean, compared to households that do not receive remittances, the households receiving remittances spend, at the margin, 10 per cent and 4 per cent less on consumption of food and durables, respectively. Moreover, the marginal increase in spending on education is 26 per cent more for a remittances-receiving household than for a non-receiving household. Finally, the households receiving remittances spend, at the margin, 14 per cent more on non-durables (which includes their spending on housing, and is thus akin to investment in physical capital) than the households with no remittances. A key feature of these results is the likely positive impact of remittances on economic development, by way of increased spending on human capital or education as well as physical capital. Remittances-receiving households appear to look at the remittance earnings as a transitory income and therefore tend to spend remittances more on investment than consumption. This finding lends support to the permanent income hypothesis.

JEL Classifications: D12 and O12

Key Words: remittances, treatment effect, consumption, Pakistan.

4.1 Introduction

During the last decade, the developing world has witnessed a phenomenal increase in the inflow of international remittances. In 2013, officially recorded international remittances to developing countries amounted to US $414 billion and were more than three times larger than the official development assistance received by these countries (World Bank, 2014). The ever-increasing magnitude of international remittances has drawn economists' interest in analysing the economic impact of these transfers on developing countries. While part of the research affirms a positive impact on poverty and health in developing countries, other studies indicate that remittances can have a negative effect on income inequality, education, labour supply and economic growth.

The purpose of this paper is to further investigate and refine the debate on two basic questions: how are remittances used by the recipients and do they have any impact on the economic development? The analysis is conducted using a nationally representative household budget survey in Pakistan, and by employing a counterfactual framework, to see how the average spending behaviour of the household would have differed had that household not produced a migrant. Also, the marginal spending behaviour of the remittances-receiving and non-receiving households is compared on their consumption of a broad range of consumption and investment goods. Understanding that decision of a household member to migrate and remit money may not be taken at random, a two-stage Heckman model is used to address the selection in unobserveables.

4.2 Literature review

There have been many empirical studies seeking to understand the reasons for migrants' remitting money back home. A few of the motives include altruism or the desire to help and care for those left behind (Brown & Poirine 2005); insurance, to mitigate against any adverse shocks that their families may face (de la Briere et al. 2002; Gubert 2002); and investment (de la Briere et al. 2002; Osili 2007). Though it is very difficult to empirically discriminate between these various motives for remitting, the literature on the use and economic impact of remittances is far more targeted. While there is general agreement that remittances reduce poverty in the developing world (Loshin et al. 2010; Adams 2006a; Adams & Page 2005; Taylor et al. 2005; Yang & Martinez 2006, among others), the impact of remittances on income inequality is debated. For instance, McKenzie and Rapoport (2007) find that income inequality reduces with the level of migration. Whereas the same finding is supported by Jones (1998), Adams (1992) finds a neutral effect for remittances on income distribution in rural Pakistan. However, other studies contest these findings and have reasoned that the Gini coefficient increases when remittance earnings are included in household income (Barham & Boucher 1998; Rodriquez 1998; Adams & Cuecuecha (2010b)).

The findings on the impact of remittances on health in developing countries are less controversial. Most studies find a favourable impact of remittances on infant mortality and child health. Duryea et al. (2005) find that international migration reduces infant mortality in the first month after the birth in large urban areas in Mexico. Reaching a slightly different conclusion, Hiderbrandt and Mckenzie (2005) find that remittances reduce infant mortality in rural areas in Mexico. Similarly, Arif (2004) finds that migration reduces infant and child mortality for female children in Pakistan. In contrast, the impact of remittances on education is controversial. Cox-Edwards and Ureta (2003) find that remittance earnings have a positive impact on school retention rates in El Salvador. On the other hand, McKenzie and Rapoprt (2006) find a negative effect on school attendance in the case of international migration in Mexico. Bilquees and Hamid (1981) find a mixed trend for school education in Pakistan. They observe that school attendance up to year 3 is higher for migrant families compared to non-migrant families. However, beyond year 3, the position reverses and more males in non-migrant families go to school as compared to migrant families.

To what extent the remittances-receiving households spend their remittances on investment and consumption is as yet unresolved. Some studies find that the marginal propensity to consume on consumption goods (such as, food and durables) for remittances-receiving households is higher than for the non-receiving households. For example, Chami et al. (2003) conclude that remittances are, typically, not invested in a productive manner and often spent on 'status-oriented' consumption goods. In the case of Pakistan, Gilani et al. (1981) show that remittances' spending is more skewed towards consumption. They show that 62 per cent of remittances are spent on current consumption, 22 per cent on real estate purchase, 11.5 per cent is used for investing in physical capital while 1.4 per cent goes to financial investment. Adams (1998) shows that international remittances have a profound effect on asset accumulation in rural Pakistan. However, other studies conclude that remittances-receiving households have a tendency to invest more of their remittances on physical and human capital. For example, Adams and Cuecuecha (2010a) find that remittances-receiving households spend less at the margin on food consumption and more at the margin on education and housing.

International remittances can have different effects on labour markets in the developing world. On the one hand, remittances may ease up the liquidity constraints for the creation of small business by the receiving households. On the other hand, remittances may also increase the reservation wage of the members of the remittances-receiving households and, therefore can reduce labour force participation. For example, Kim (2007) finds that labour force participation in Jamaica decreases with remittances while Funkhouser (2006) has found the same result for Nicaragua. Likewise, Arif (2004) also finds that international migration has a negative and significant impact on labour force participation in Pakistan.

4.3 Data

This paper uses the data from Pakistan Social and Living Standards Measurement Survey (PSLM) 2010-11, collected nationwide by the Government of Pakistan Federal Bureau of Statistics. The data comprises 16,339 households and is representative both at the national level and for urban and rural areas. The sample design consisted of two-stage stratified random sampling, with enumeration blocks and villages (the primary sampling units) in urban domain and rural areas, respectively, being selected in the first stage while households (the secondary sampling units) within the sample enumeration blocks/villages have been selected at random at the second stage. At both stages, probability proportional to the size measure of sampling had been used. Accordingly, the data set comes with sampling weights for each household and the same have been used in this paper for carrying out estimations.[8] Although the survey is comprehensive and covers the household's expenditure and income patterns, it is not a specialized survey of remittances. As regards remittances, the survey only gathers information relating to three basic questions: remittance received (in cash) from outside Pakistan, country of residence of remitters and relationship of the remitter with the head of the household. Neither does it have data on migrants' characteristics; only migrants who remit (and whose remittances are declared by the recipient households) are captured by the survey. Non-availability of data relating to migrants impedes us from observing the effect of migration on households' expenditure patterns. Notwithstanding

[8] The probability weights included in the data set usually incorporates corrections for non-response and non-coverage. It is therefore, not advisable to modify the probability weights.

the lack of information regarding individual migrant characteristics, the expenditure data included in the survey is of high quality. And this makes it possible to use the response to these three questions in examining the impact of remittances on households' expenditure patterns. Table 4.1 presents summary data on remittances-receiving and non-receiving households. Remittances-receiving households are defined as households receiving remittances from outside Pakistan (international remittances). Out of a total of 16,339 households, 871 households receive international remittances. For households receiving remittances, mean per capita expenditure is significantly higher than it is for non-receiving households. Moreover, the average assets holding for remittances receiving households is significantly higher than it is for non-receiving households. Remittances receiving households are proportionally higher in rural areas: 74.7 per cent of the remittances receiving households are located in rural areas as compared to 61.7 per cent of the non-receiving households.

Table 4.1 Summary data on remittance receiving and non-receiving households

Variable	Households receiving remittances (remitdum=1) (mean)	Households not receiving remittances (remitdum=0) (mean)	Difference [=remitdum(0)-remitdum(1)]	p-value
Household size	7.171	6.654	-0.517	0.000***
Log of per capita expenditure	10.737	10.437	-0.3	0.000***
The household has members in the 0 to 10 years age group (1 = yes)	0.707	0.696	-0.011	0.717
The household has members in the 11to 19 years age group (1 = yes)	0.678	0.592	-0.086	0.000***
The household has members in the 20 to 60 years age group (1=yes)	0.988	0.986	-0.002	0.820
The household has members in the 61 and older years age group (1 = yes)	0.373	0.260	-0.113	0.000***
The household has members with primary level of education (1 = yes)	0.763	0.632	-0.131	0.000***
The household has members with secondary level of education (1 = yes)	0.464	0.345	-0.119	0.000***
The household has members with higher secondary level of education (1 = yes)	0.209	0.175	-0.034	0.004**
The household has members with Bachelor's degree level	0.143	0.107	-0.036	0.025**

of education (1 = yes)				
The household has members with Master's degree level of education (1 = yes)	0.053	0.054	0.0005	0.576
Total assets owned by the household (PKR)	3,042,649	1,620,982	-1,421,667	0.000***
Amount of loan owed by the household (PKR)	53,325	25,701	-27,624	0.000***
Province1 (=Punjab)	0.634	0.591	-0.043	0.000***
Province2 (=Sindh)	0.018	0.248	0.230	0.000***
Province3 (=Khyber Pakhtunkhwa)	0.332	0.112	-0.220	0.000***
Province4 (=Baluchistan)	0.016	0.048	0.032	0.000***
Rural area (1=yes)	0.746	0.617	-0.129	0.001***

Notes: N=16,339 households; 871 households receive foreign remittances. All the values are weighted.

** Significant at the 0.05 level.

*** Significant at the 0.01 level.

Source: Author's calculations based on Pakistan Social and Living Standards Measurement Survey (PSLM) 2010-1.

Table 4.2 presents information on five different categories of expenditure. The base period over which these expenditures were measured varied from the last 14 days for most food items to the last month and the last one year for non-durable and durable items. Therefore, all expenditures have been aggregated to yearly values. The table also shows households' average budget shares on these five categories of goods.

Table 4.2 Expenditure portfolios and average budget shares

Category	Description	Examples	Average expenditure shares: receiving remittances (remitdum=1)	not receiving remittances (remitdum=0)	Difference [=remitdum(0) -remitdum(1)]	p-value
Food	Paid and consumed, Unpaid and consumed	Milk and milk products, meat, wheat, rice; Wages and salaries consumed in kind; own production; receipt from assistance, gift or other sources	0.475	0.510	0.035	0.000***
Education	Educational expenditure	School/college fee and private tuition fee; books, stationary and professional society membership; hostel expenses.	0.039	0.022	-0.017	0.000***
Health	Medical care expenses	Medicine, doctor fees, hospitalization charges, dental care.	0.029	0.028	-0.001	0.037**
Non-durables	Household non-durables	Housing; fuel and lighting; personal care like bath soap, shampoo; personal transport and travelling; recreation; clothing, foot ware.	0.157	0.128	-0.029	0.000***
Durables	Household durables	Wrist watches, sun glasses, furniture, Television, car,	0.026	0.014	-0.012	0.000***

		computer, mobile.				
Other goods	Household expenditure on other goods and services	Miscellaneous goods and services	0.275	0.299	0.024	0.000***

Notes: ** Significant at the 0.05 level.

*** Significant at the 0.01 level.

Source: Author's calculations based on Pakistan Social and Living Standards Measurement Survey (PSLM) 2010-11.

4.4 Choice of functional form for the model

The analysis of marginal expenditure patterns of households requires an appropriate functional form for the econometric model. Broadly, the selection should be based upon two factors. First, it is desirable that the model possesses appropriate microeconomic foundations and second, it should have good statistical properties. A useful functional form, relating the expenditure shares to the logarithm of total expenditure is the Working-Leser model. This model is given by[9]

$$C_{ij}/EXP_i = \beta_j + \alpha_j/EXP_i + \gamma_j(logEXP_i) \quad \text{for} \quad i = 1\ to\ N \text{ and } \quad j = 1\ to\ m \tag{1}$$

where C_{ij}/EXP_i is households i's share of expenditure on good j in its total expenditure EXP_i and $\sum_{j=1}^{k} C_{ij}/EXP_i = 1$.

Alternatively, equation (1) can be written as

$$C_{ij} = \alpha_j + \beta_j EXP_i + \gamma_j(EXP_i)\log(EXP_i) \tag{2}$$

which is the Engel function. Theoretically, Engel functions can be defined as Marshallian demand functions, holding prices of all goods fixed. The empirical Engel function defined in equation (2) coincides with the theoretical Engel function, provided all the sampled households pay the same price for all goods. And, in cross sectional

[9] Originally proposed by Working (1943) the model was further elaborated by Leser (1963) and since then, has been widely used by others. See Deaton and Muellbauer (1980), Adams (2006b) and Adams and Cuecuecha (2010a).

data, all the sampled households are assumed to face the same prices for all goods.[10] One obvious departure is the use of total expenditure instead of total income. This is because in surveys, households' incomes are prone to measurement error.[11] As regards the second factor, the chosen functional form should provide a decent statistical fit for different variety of goods, have the mathematical property of exhibiting variation in marginal propensities with respect to different varieties of goods and expenditure level, and should conform to the additivity criterion (that is, marginal propensities for all goods should sum up to unity). Gauged on the above criteria, the Working-Leser model is an appropriate model to use.

However, in analysing the expenditure pattern of households with different levels of income, other socioeconomic and demographic variables influencing their behaviour must also be taken into account. Differences in observed expenditure may be partly explained by differences in income, but also by differences in family composition, educational status of household members, age composition of household members, liquidity constraints and whether the household receives remittances or not. Denoting the household h's characteristics by Z_h, with μ_{ij} being constants, equation (1) can be written as

$$C_{ij}/EXP_i = \beta_j + \alpha_j/EXP_i + \gamma_j(logEXP_i) + \sum_h(\mu_{jh})(Z_h) \quad (3)$$

The marginal budget share for good 'j' can be derived from equation (3) as

$$MBS_j = dC_{ij}/EXP_i = \beta_j + \gamma_j(1 + logEXP_i) + \sum_h(\mu_{jh})(Z_h) \quad (4)$$

Equation (4) shows by how much consumption share of good 'j' will change in response to one rupee increase in household expenditure, keeping constant household characteristics Z_h. The model, in this formulation, is the one used by Adams and Cuecuecha (2010a).

4.5 Model estimation

To estimate the effect of remittances on households expenditure behaviour, literature on treatment effects will be followed. Formally, treatment effects are best understood under

[10] In cross sectional survey data, observed price variation entails no meaningful information on estimating demand responses to changes in prices of goods of same quality (Chern et al. 1993; George and King 1971)

[11] Engel and Kneip (1996) highlight that household diposable income measures are erratic in surveys. Agrarian economies are prone to severe measurement errors (Bhalotra & Attfield, 1998)

the potential (counterfactual) framework. Defining treatment as the condition where the households have a remitter, remittances receiving households can be qualified as a 'treated' group, whereas non-receiving households will be akin to a 'control' group. Consider a household 'i' that did not receive treatment (has no remitter) so that we observe the budget share on a commodity group 'j' for this household to be y_{0i}. The potential outcome or the counterfactual for the same household would be y_{1i}, which we would have observed if this household had been exposed to treatment. And for a household receiving treatment, we observe y_{i1} so that y_{0i} would be potential outcome for that household. This means that, in observational data we either observe y_{0i} or y_{1i} for a given household with observable characteristics, $\boldsymbol{X}_i$. Let t_i be an indicator variable indicating treatment condition so that $t_i = 1$ if household 'i' received treatment and $t_i = 0$ otherwise, so that the observed expenditure share of household i on good 'j' is given by

$$y_i = (1 - t_i)y_{0i} + t_i y_{1i} \tag{5}$$

where

$$y_{0i} = E(y_{0i}) + \varepsilon_{0i} \tag{6}$$

and

$$y_{1i} = E(y_{1i}) + \varepsilon_{1i} \tag{7}$$

where $\varepsilon_{0i}$and ε_{1i} are mean zero error terms.

This relation links together the observable and non-observable outcomes with the treatment indicator and is called the (Potential) Outcome Model. Since y_{1i} and y_{0i} are never both observed for the same household, research on causal effect tries to capture

i. The potential outcome means (POMs), $\mathrm{E}(y_1)$ and $\mathrm{E}(y_0)$ of the treated and the untreated respectively,[12]
ii. The average treatment effect (ATE), which is the mean of the difference $(y_1 - y_0)$ i.e $\mathrm{ATE} = \mathrm{E}(y_1 - y_0)$. This is the average effect of moving the entire population from untreated to treated (Austin 2011),

[12] For ease of reference, the subscript referring to household i is not used when measuring population parameters.

iii. The average treatment effect on the treated (ATET), which is the mean of the difference $(y_1 - y_0)$ among those houeholds that receive the treatment $(\text{ATET} = \text{E}(y_1 - y_0)|t_i = 1)$,

iv. The average treatment effect on non-treated (ATENT), is the average effect of treatment on randomly drawn sub-population, selecting (or assigned) no treatment. $(\text{ATENT} = \text{E}(y_1 - y_0)|t_i = 0)$.

Causal parameters are not as easy to measure as they are to describe. For example, the POM for the untreated can be calculated as

$$\text{E}(y_0) = \text{E}((y_0|t_i = 0)\Pr(t_i = 0) + \text{E}((y_0|t_i = 1)\Pr(t_i = 1) \qquad (8)$$

Here, the term $\text{E}((y_0|t_i = 1)$ is not identified by the data. By analogy, $\text{E}(y_1|t_i = 0)$ is also not identified. And the objective is to recover consistent and efficient estimators for the treatment effects from the actually observed data. In a sample drawn randomly (which is rarely possible in observational data), the 'difference in mean' estimator is a consistent and unbiased estimator for the ATE. This requires that (y_1, y_0) are independent of treatment variable, t_i $(\text{E}(y_{0i}|t_i = 1) = \text{E}(y_{0i}|t_i = 0)\ and\ \text{E}(y_{1i}|t_i = 1) = \text{E}(y_{1i}|t_i = 0))$. If this Random Assignment (RA) assumption is violated, the observed difference in outcomes between those with $t_i = 1$and $t_i = 0$ will equal $\text{E}(y_{1i} - y_{0i}|t_i = 1)$ plus a bias term:

$$\text{E}(y_i|t_i = 1) - \text{E}(y_i|t_i = 0) = \text{E}(y_{1i}|t_i = 1) - \text{E}(y_{0i}|t_i = 0)$$

$$= \text{E}(y_{1i}|t_i = 1) - \text{E}(y_{0i}|t_i = 1) + \text{E}(y_{0i}|t_i = 1) - \text{E}(y_{0i}|t_i = 0)$$

$$= \text{E}(y_{1i} - y_{0i}|t_i = 1) + \text{E}(y_{0i}|t_i = 1) - \text{E}(y_{0i}|t_i = 0) \qquad (9)$$

The bias term disappears when the decision to migrate and remit money is determined in a manner independent of households' potential expenditure. But this independence assumption is not realistic, since the decision to migrate is taken in light of information (observable) about family circumstances and (unobservable) ability, motivation and the propensity to take risk. If selection bias is only due to observable characteristics of households such as household size, number of household members in different age categories, education level of household members, wealth status, geographic location etc, then knowledge of these covariates may be sufficient to identify the causal parameters. This assumption, known as Conditional (Mean) Independence (CMI), states that conditional on covariates, $\mathbf{x}_i$, the regressor of interest, t_i, is independent of potential outcomes and the condition of randomization is restored.[13] Then any causal effect (ATE, ATET, ATENT) can be consistently estimated from weighted conditional-on-***X*** comparisons (Angrist 2004).[14]

From equations (5), (6) and (7), the observed expenditure share of household i can be written as

$$y_i = \mathrm{E}(y_{0i}) + t_i\{\mathrm{E}(y_{1i}) - \mathrm{E}(y_{0i})\} + \varepsilon_{0i} + t_i(\varepsilon_{1i} - \varepsilon_{0i})$$

$$= \mathrm{E}(y_{0i}) + at_i + \varepsilon_{0i} + t_i(\varepsilon_{1i} - \varepsilon_{0i}) \qquad (10)$$

Equation (10) is called the (potential) outcome equation. Here $a = ATE$.[15] Under the standard regularity conditions and assuming that

$$\mathrm{E}\{\varepsilon_{0i} + t_i(\varepsilon_{1i} - \varepsilon_{0i})|\mathbf{x}_i, t_i\} = 0 \qquad (11)$$

a can be estimated consistently by OLS. In this situation, t_i is exogenous.[16] However, when treatment is endogenous, (11) does not hold and OLS estimate will be biased. However, if the conditional mean independence assumption holds, we can write (8) as[17]

$$\mathrm{E}(y_i)|\mathbf{x} = \mathrm{E}(y_{0i}) + at_i + g_0(\mathbf{x}) + t_i\{g_1(\mathbf{x}) - g_0(\mathbf{x})\} \qquad (12)$$

where $g_0(\mathbf{x}) = \mathrm{E}(\varepsilon_{0i}|\mathbf{x})$, $g_1(\mathbf{x}) = \mathrm{E}(\varepsilon_{1i}|\mathbf{x})$

If the household-specific error components are decomposed into an observed component and unobserved term, we can write ε_{0i} and ε_{1i} in equations (6) and (7) as

$$\varepsilon_{0i} = g_0(\mathbf{x}) + e_{0i} = \beta_0\mathbf{x}_i + e_{0i}, \qquad \mathrm{E}(e_{0i}|\mathbf{x}, t_i) = \mathrm{E}(e_{0i}|\mathbf{x}) = 0$$

$$\varepsilon_{1i} = g_1(\mathbf{x}) + e_{1i} = \beta_1\mathbf{x}_i + e_{ii}, \qquad \mathrm{E}(e_{1i}|\mathbf{x}, t_i) = \mathrm{E}(e_{1i}|\mathbf{x}) = 0 \qquad (13)$$

where a linear functional form is assumed for g_0 and g_1. With these substitutions, we can write (10) as

[13] Imbens (2004) refers to this as the confoundedness assumption, Rubin (1978) calls it the ignorabiltiy assumption

[14] Under the observable confounding covariates, **x,** the conditional treatment parameters can be represented as; $\mathrm{ATE}_{\mathbf{x}} = \mathrm{E}(y_1 - y_0)|\mathbf{x}$; $\mathrm{ATET}_{\mathbf{x}} = \mathrm{E}(y_1 - y_0)|\mathbf{x}, t_i = 1$; $\mathrm{ATENT}_{\mathbf{x}} = \mathrm{E}(y_1 - y_0)|\mathbf{x}, t_i = 0$

[15] α is the average treatment effect of a "randomly" assigned household. There are no households that are randomly assigned, but the term is used to convey the idea that the unobservables affecting the treatment decision that are correlated with expenditure have been controlled for. Heckman (1990) refers to this as the experimental treatment average

[16] If the covariances for the pairs $(e_{0i,}u_i)$ and $(e_{1i,}u_i)$ are represented by σ_{0u} and σ_{1u}, respecitively then, under normality, a necessary and sufficient condition for (9) to hold is $\sigma_{1u} = \sigma_{0u} = 0$, which means that the unobservable components of the outcome equation are irrelevant to the treatment decision (Vella & Verbeek 1999).

[17] Conditional mean independence implies, $E(y_{0i}|\mathbf{x}, t_i) = E(y_{0i}|\mathbf{x})$; and $E(y_{1i}|\mathbf{x}, t_i) = E(y_{1i}|\mathbf{x})$

$$y_i = \mathrm{E}(y_{0i}) + at_i + g_0(\mathbf{x}) + t_i\{g_1(\mathbf{x}) - g_0(\mathbf{x})\} + e_{0i} + t_i(e_{1i} - e_{0i}) \quad (14)$$

and,

$$y_i = \{\mathrm{E}(y_{0i}) - \beta_0\mathbf{x}_i\} + at_i + \beta_0\mathbf{x}_i + t_i\{\mathbf{x}_i - \mu_{\mathbf{x}}\}(\beta_1 - \beta_0) + + e_{0i} + t_i(e_{1i} - e_{0i}) \text{ or}$$

$$y_i = \alpha_0 + at_i + \beta_0\mathbf{x}_i + t_i\{\mathbf{x}_i - \mu_{\mathbf{x}}\}\,\boldsymbol{\delta} + e_{0i} + t_i(e_{1i} - e_{0i}) \quad (15)$$

where $\alpha_0 = \{\mathrm{E}(y_{0i}) - \beta_0\mathbf{x}_i\}$ is the intercept; $\boldsymbol{\delta} = (\beta_1 - \beta_0)$ and $\mu_{\mathbf{x}} = E(\mathbf{x}_i)$

Equation (15) provides a general representation of the outcome equation, taking into account both observable heterogeneity ($\beta_0 \neq \beta_1 \Rightarrow \boldsymbol{\delta} \neq 0$), and unobservable heterogeneity ($e_{1i} \neq e_{0i}$). If the CMI assumptions of (13) hold, we can write the conditional expectation of (15) as

$$\mathrm{E}(y_i|\mathbf{x}, t_i) = \mathrm{E}(y_i)|\mathbf{x} = \mathrm{E}(y_{0i}) + at_i + \beta_0\mathbf{x}_i + t_i\{\mathbf{x}_i - \mu_{\mathbf{x}}\}\boldsymbol{\delta} + 0 \quad (16)$$

The last two terms in equation (16) represent the Control Function (CF): when added to the regression of y on a constant and the indicator variable, t_i, they control for possible selection bias, and the coefficient on t_i will give an estimate for ATE, which can be consistently estimated by OLS.

However, when the conditional mean assumption does not hold, CF regression will result in biased estimates of treatment parameters. This will happen if non-random assignment of households into treatment is not only due to observable characteristics, but also observables. Two classes of model are of particular suitability in this case: the Heckman Selection Model (HSM) and the Instrumental Variables Regression (IVR) approach. In a recent study, DeMaris (2014) compares the performance of HSM and IVR to that of Ordinary Least Squares (OLS) when both treatment and unmeasured confounding is present and absent. He finds that HSM outperforms IVR on account of mean square error estimate of treatment as well as power of detecting either unobserved confounding or treatment effect. In this paper, we focus on the estimation of the average treatment effect and use the HSM for its estimation.

Assuming that households wish to maximize their utility, the decision to migrate and remit (assignment to treatment) is given by

$$t_i = I(y_{1i} - y_{0i}) > 0 = I(\gamma_0 + \gamma_1\mathbf{x}_i + \gamma_2 Z_i + u_i > 0) \quad (17)$$

where $I(.)$ is an indicator function which implies that $t_i = 1$, if $\gamma_0 + \gamma_1 \mathbf{x}_i + \gamma_2 Z_i + u_i > 0$ and $t_i = 0$, otherwise. Z_i is a vector of exogenous observed variables that affect assignment to treatment and u_i is the idiosyncratic component of the household that captures the unobservables that affect the treatment and having a variance, σ_u^2. Assuming $(u_i, \varepsilon_{0i}, \varepsilon_{1i})$ to be independent of $(\mathbf{x}_i, Z_i)$, with trivariate normal distribution, and assuming the conditional mean redundancy assumptions[18], i.e.,

$$E(\varepsilon_{0i}|\mathbf{x}, Z) = E(\varepsilon_{0i}|\mathbf{x}) \text{ and } E(\varepsilon_{1i}|\mathbf{x}, Z) = E(\varepsilon_{1i}|\mathbf{x}), \tag{18}$$

we can write the conditional expectation of y_i in equation (15) as

$$\mathrm{E}(y_i|\mathbf{x}, Z_i, t_i) = \mathrm{E}(y_{0i}) + a t_i + \beta_0 \mathbf{x}_i + t_i\{\mathbf{x}_i - \mu_{\mathbf{x}}\}\boldsymbol{\delta} + t_i E(e_{1i}|\mathbf{x}, Z_i, t_i = 1)$$

$$+(1 - t_i)E(e_{0i}|\mathbf{x}, Z_i, t_i = 0) \tag{19}$$

Under normality of the error terms, and normalizing σ_u^2 to unity so that $u_i \sim N(0,1)$, the two conditional expectations in equation (18) can be written as (for proof see Appendix 4A),

$$\mathrm{E}(e_{1i}|\mathbf{x}, Z_i, t_i = 1) = E(e_{1i}|u_i < q\gamma',) = \rho_{1u}\sigma_1 \left\{\frac{\phi(q\gamma')}{1-\Phi(q\gamma')}\right\} \tag{20}$$

and

$$\mathrm{E}(e_{0i}|\mathbf{x}, Z_i, t_i = 0) = E(e_{0i}|u_i < -q\gamma',) = \rho_{0u}\sigma_0 \left\{\frac{-\phi(q\gamma')}{\Phi(q\gamma')}\right\} \tag{21}$$

where

$$\lambda_i(q_i\gamma') = \mathrm{E}(u_i|\mathbf{x}, Z_i, t_i) = t_i \frac{\phi(Z_i\gamma')}{1-\Phi(Z_i\gamma')} + (1 - t_i)\frac{-\phi(Z_i\gamma')}{\Phi(-Z_i\gamma')} \tag{22}$$

Equation (19) along with (20) and (21) will estimate the model under both observable and unobservable heterogeneity. Here, ρ_{0u} and ρ_{1u} are the correlation coefficients between the pairs (e_{0i}, u_i) and (e_{1i}, u_i)[19], respectively; ${\sigma_0}^2$ and ${\sigma_1}^2$ are the respective variances of e_{0i} and e_{1i} , and λ_i is known as the inverse Mills ratio or the hazard

[18] The redundancy condition implies that Z is uncorrelated with ε_{0i} and ε_{1i}

[19] Imposing the restriction $\rho_{0u} = \rho_{1u}$ implies (unobservable) homogenous treatment effect; a sufficient condition for this to happen is that $e_{0i} = e_{1i}$, which means that the heterogeneity is only due to observables.

function. $q\gamma \equiv \gamma_0 + \gamma_1 \mathbf{x}_i + \gamma_2 Z_i$, $\phi(q\gamma')$ and $\Phi(q\gamma')$ are the density function and the distribution function of the standard normal evaluated at $q\gamma'$ ($\gamma' = \frac{\gamma}{\sigma_u}$).

The model can be estimated in two stages:

1. Run a probit regression of t_i on $(1, \mathbf{x}_i, Z_i)$ and get $\left(\hat{\phi}_i, \hat{\Phi}_i\right)$
2. Run an OLS of C_{ij}/EXP_i on $\left\{1, t_i, \mathbf{x}_i, t_i(\mathbf{x}_i - \mu_{\mathbf{x}}), \frac{t_i\hat{\phi}(q\gamma')}{1-\hat{\Phi}(q\gamma')},\ (1-t_i)\frac{-\hat{\phi}(Z_i\gamma')}{\hat{\Phi}(-Z_i\gamma')}\right\}$

The coefficient on t_i is a consistent estimator of a, the ATE (Wooldridge 2010, p.631). We use the *ivtreatreg* command developed by Cerulli (2014) for estimating the treatment effects. This command also estimates the conditional treatment parameters: ATE(x); ATET(x); and ATENT(x) as:

$$ATE(\mathbf{x}) = \mathrm{E}(y_1 - y_0|\mathbf{x}) = \boldsymbol{\alpha} + (\mathbf{x} - \bar{\mathbf{x}})\ \boldsymbol{\delta} \quad (23)$$

$$ATET(\mathbf{x}) = \mathrm{E}(y_1 - y_0|\mathbf{x}, t_i = 1) = \{\boldsymbol{\alpha} + (\mathbf{x} - \bar{\mathbf{x}})\ \boldsymbol{\delta} + (\rho_{0u} + \rho_{1u})\boldsymbol{\lambda_1}(q\gamma')\}_{t_i=1} \quad (24)$$

$$ATENT(\mathbf{x}) = \mathrm{E}(y_1 - y_0|\mathbf{x}, t_i = 0) = \{\boldsymbol{\alpha} + (\mathbf{x} - \bar{\mathbf{x}})\ \boldsymbol{\delta} + (\rho_{0u} + \rho_{1u})\boldsymbol{\lambda_0}(q\gamma')\}_{t_i=0} \quad (25)$$

4.6 Model specification

In the first stage, the probability that a household receives remittances is estimated using the following specification for the choice (selection) model:

Prob (Household=remittances)

= *f* [Household characteristics (household size × presence of household members in 0-10 years age group × presence of household members in 11-19 years age group × presence of household members in 20-60 years age group), Human Capital (presence of household members with primary level education × presence of household members with secondary level education × presence of household members with higher secondary level of education × presence of household members with a Bachelor's degree × presence of households with a Master's degree and above), Wealth characteristics (Value of total assets owned by the household × Value of total loan owed by the household) × Rural/Urban Dummy variable, Provincial Dummy variable]

The variables included in the first stage regression beget their inclusion from standard literature. Education is likely to affect the decision to migrate because the possibilities of higher earnings in destination areas increase with the level of education (Faggian et al. 2007; Ritsilä & Ovaskainen, 2001; Todaro, 1969). In the literature, one also finds support for including the household characteristics in determining the likelihood to migrate. Households possess a set of resources that are fixed in the short run: land is fixed in the form of agricultural land, labour in the form of number, age and sex of its members and capital in the form of savings and wealth. A household, therefore, allocates its labour supply to different productive pursuits, including migration, to effectively utilize its combined resources (Massey et al. 1990; Harbison, 1981). Along with the dummy variables for the human capital variables and the household characteristics, a rural dummy is included to indicate whether or not the household belongs to rural area. Four provincial dummies are included for each of the four provinces. Finally, the wealth variables include the total assets owned and loan owed by the household. Total assets refer to the expected price the household would get from selling the assets in its possession and include personal agricultural land, livestock, sheep, goat, poultry and animals in personal possession for transportation, non-agricultural land or property in personal possession, residential building in personal possession and a shop or commercial building in personal possession.

The second stage regression specifies the expenditure shares and is estimated as

$$\begin{aligned} C_{ij}/EXP_i &= \beta_j + a_j(Remitdum) + \gamma_j(lpce) + \alpha_j(inv\_pce) \\ &+ \mu_{j1}(age\_1) + \mu_{j2}(age\_2) + \mu_{j3}(age\_3) + \mu_{j4}(age\_4) \\ &+ \mu_{j5}(educ5) + \mu_{j6}(educ10) + \mu_{j7}(educ12) + \mu_{j8}(educ14) \\ &+ \mu_{j9}(educ16) + \mu_{j10}(totalassets) + \mu_{j11}(loan) \\ &+ \mu_{j12}(SINDH) + \mu_{j13}(KHYBER\_PAKHTUNKHWA) \\ &+ \mu_{j14}(BALUCHISTAN) + \mu_{j15}(rural) + \mu_{j16}\left(\lambda_{0j}\right) \\ &+ \mu_{j17}\left(\lambda_{1j}\right) \qquad (26) \end{aligned}$$

where C_{ij}/EXP_i is the share of household expenditure on the five categories defined in Table 2, $Remitdum$ is a dummy variable and is 1 if the household receives remittances from abroad (outside Pakistan), $lpce$ is the log of total annual per capita expenditure, inv_pce is the reciprocal of annual per capita expenditure, age_1 is one if the household has children below age 10, age_2 is one if the household has members between the age of 11-years and 19-years, age_3 is one if the household has members between the age of 20-years and 60-years, age_4 is one if the household has members above 60-years of age, $educ5$ is one if the household has members with primary level (5-years) education, $educ10$ is one if the household has members with secondary level (10-years) education, $educ12$ is one if the household has members with higher secondary level (12-years) of education, $educ14$ is one if the household has members with a Bachelor's degree, $educ16$ is one if the household has members with a Master's or above degree, $totalassets$ is the value of the total assets owned by the household in Pak Rupee (PKR), $loan$ is the loan owed by the household in PKR, $SINDH$, $KHYBER\_PAKHTUNKHWA$ and $BALUCHISTAN$ are the regional dummies for the respective three provinces (the dummy for the fourth province, PUNJAB, is omitted as it is used as a base category in estimation), $rural$ is one if the household belongs to rural region, λ_{0j} and λ_{1j} are the selection correction variables (as defined in equation (22)).

4.7 Estimation results of the model

The results from the first stage probit model are represented in Table 4.3. The results show some interesting features. For example, if the households have children below the age of 10 years, then there is more migration overseas and more households would receive remittances. Likewise, the presence of teenage members and/or aged family members also increases the likelihood of a family member migrating and the household receiving more remittances.

Having an elderly member above the age of 60 years also significantly increases the probability of a family member migrating and sending remittances. The human capital variables are even more interesting. Households having less educated members are more likely to have an emigrant member, whereas households with highly educated members are less likely to have a member migrating.

Table 4.3 Probit estimates from first stage regression

Variable	**Coefficient**	**Standard errors**	**Marginal effect**
Household size	.0403***	.00981	0.004
There are children below 10 years in household (1=yes)	0.223***	.0553	0.020
There are members between 10 and 20 years in household (1=yes)	0.165***	.0523	0.015
There are members between 20 and 60 years in household (1=yes)	0.238	0.209	0.019
There are members older than 60 years in household (1=yes)	0.186***	.0485	0.018
There are household members with primary level education (1=yes)	0.148***	0.0515	0.013
There are household members with secondary level education (1= yes)	0.0887*	0.0478	0.008
There are household members with higher secondary level education (1=yes)	-0.0956	0.0609	-0.008
There are household members with Bachelor's degree level education (1=yes)	-0.0256	0.0727	-0.002
There are household members with Master's degree level or more education (1=yes)	-0.414***	0.102	-0.031
Total assets owned by the household (PKR)	-4.61e-09	3.89e-09	-4.34e-10
Amount of loan owed by the household (PKR)	7.34e-08	1.44e-07	6.90e-09

PUNJAB	Base Province		
SINDH	-1.049***	0.0991	-0.058
KHYBER PAKHTUNKHWA	0.533***	0.0461	0.063
BALUCHISTAN	-0.438***	0.0903	-0.031
Household belongs to rural area (1=yes)	0.253***	.0506	0.022
Constant	-5.736***	1.433	0
F-statistic	36.44		
N	16339		

Notes: * p<0.10, ** p<0.05, *** p<0.010.

For example, it is 1.3 per cent and about 1 per cent more likely for a household having a respective member or members with primary and secondary level education to migrate. However, it is 3 per cent less likely for a household having a member with at least master's level of education to have a migrating member. Thus, it can be reasoned that the tendency of international migration is more for a household having unskilled or semiskilled family composition. The regional variables are all strongly significant and reveal inter-provincial and intra-provincial preferences for migration. Compared to Punjab, which is the most populous province, households in the province of Sindh are 6 per cent less likely to migrate and send remittances, whereas, it is 6 per cent more likely for the households in Khyber Pakhtunkhwa to have a family member working overseas and remitting money. Similarly, rural households are expected more to have a migrant family member and therefore, more number of households in rural areas are likely to be receiving international remittances.

Table 4.4 presents the results of the second stage regression for each expenditure type. The results give the Average Treatment Effect (ATE), which is the coefficient for the binary variable of household receiving remittances or not. The average causal effect of remittances on a household is that it spends less on food and more on education, health, non-durables and durables. It is also observed that the coefficient for log of per capita expenditure is negative and highly significant for expenditure share on food. This indicates that Engel's law holds. The most important variable is the inverse Mill's ration, λ_t which is the selection term in our model. The λ_t variable is significant for all expenditure categories, which suggests that selection in unobservables cannot be ruled out for households receiving remittances. Without this term included, the regression coefficients would have been biased.

Table 4.4 Expenditure estimates, corrected for selection bias.

Variable	**Food**	**Education**	**Health**	**Non-durables**	**Durables**
Household receiving remittances (1=yes)	-0.120***	0.056***	0.003	0.087***	0.091***
Log of per capita expenditure	-0.145***	0.018***	-0.005***	0.054***	0.013***
Reciprocal of per capita expenditure	-2238.6***	311.6***	-122.5***	918.7***	389.9***
There are children below 10 years in household (1=yes)	-0.006***	0.007***	-0.002***	0.058***	-0.002***
There are members between 10 and 20 years in household (1=yes)	0.002	0.012***	-0.003***	0.052***	-0.003***
There are members between 20 and 60 years in household (1=yes)	-0.013**	0.006**	-0.012***	0.0337***	0.006**
There are members older than 60 years in household (1=yes)	0.009***	-0.005***	0.001*	-0.011***	-0.004***
There are household members with primary level education (1=yes)	-0.01***	0.005***	-0.0002	0.035***	0.002***
There are household members with secondary level education (1= yes)	-0.012***	0.007***	-0.002***	0.019***	-0.0006
There are household members with higher secondary level	-0.015***	0.012***	-0.001	0.025***	0.003***

education (1=yes)					
There are household members with Bachelor's degree level education (1=yes)	-0.016***	0.009***	-0.002*	0.028***	-0.0006
There are household members with Master's degree level or more education (1=yes)	-0.019***	0.015***	0.0003	0.013***	0.00002
Total assets owned by the household (PKR)	-1.19e-10	-2.77e-11	-4.98e-11	3.33e-11	-7.59e-11*
Amount of loan owed by the household (PKR)	-3.20e-08***	7.42e-09***	1.73e-08***	-5.87e-10	1.51e-08***
PUNJAB	Base province	Base province	Base province	Base province	Base province
SINDH	0.028***	-0.011***	-0.003***	-0.02***	0.0007
KHYBER PAKHTUNKHWA	0.033***	-0.006***	0.01***	-0.024***	-0.017***
BALUCHISTAN	0.041***	-0.014***	-0.01***	-0.012***	-0.002**
Household belongs to rural area (1=yes)	0.062***	-0.006***	0.002***	-0.055***	-0.001
λ_0	-0.094***	0.022***	0.027***	0.078***	0.113***
λ_1	0.046***	-0.021***	-0.0005	-0.029**	-0.035***
Constant	2.094***	-0.205***	0.106***	-0.575***	-0.156***
Adj. R-squared	0.474	0.231	0.065	0.28	0.098
N	16339	16339	16339	16339	16339

Notes: * p<0.10, ** p<0.05, *** p<0.010.

Figure 4.1 shows the distributions of the conditional treatment parameters: ATE(x), ATET(x) and ATENT(x) for the five categories of expenditure shares. For food, ATET(x) shows a distribution, which is more negative than the distribution of ATE(x) and ATENT(x). This predicts that the expenditure share on food for households who receive remittances would have been more if they had not been receiving remittances. Similarly, in respect of the other four categories of education, health, non-durables and durables, the distribution of ATET(x) predicts that the remittances receiving households would have been spending less on these goods had they not been receiving remittances.

Figure 4.1 Distribution of ATE(x) ATET(x) and ATENT(x) for the five cateogries of expenditure shares

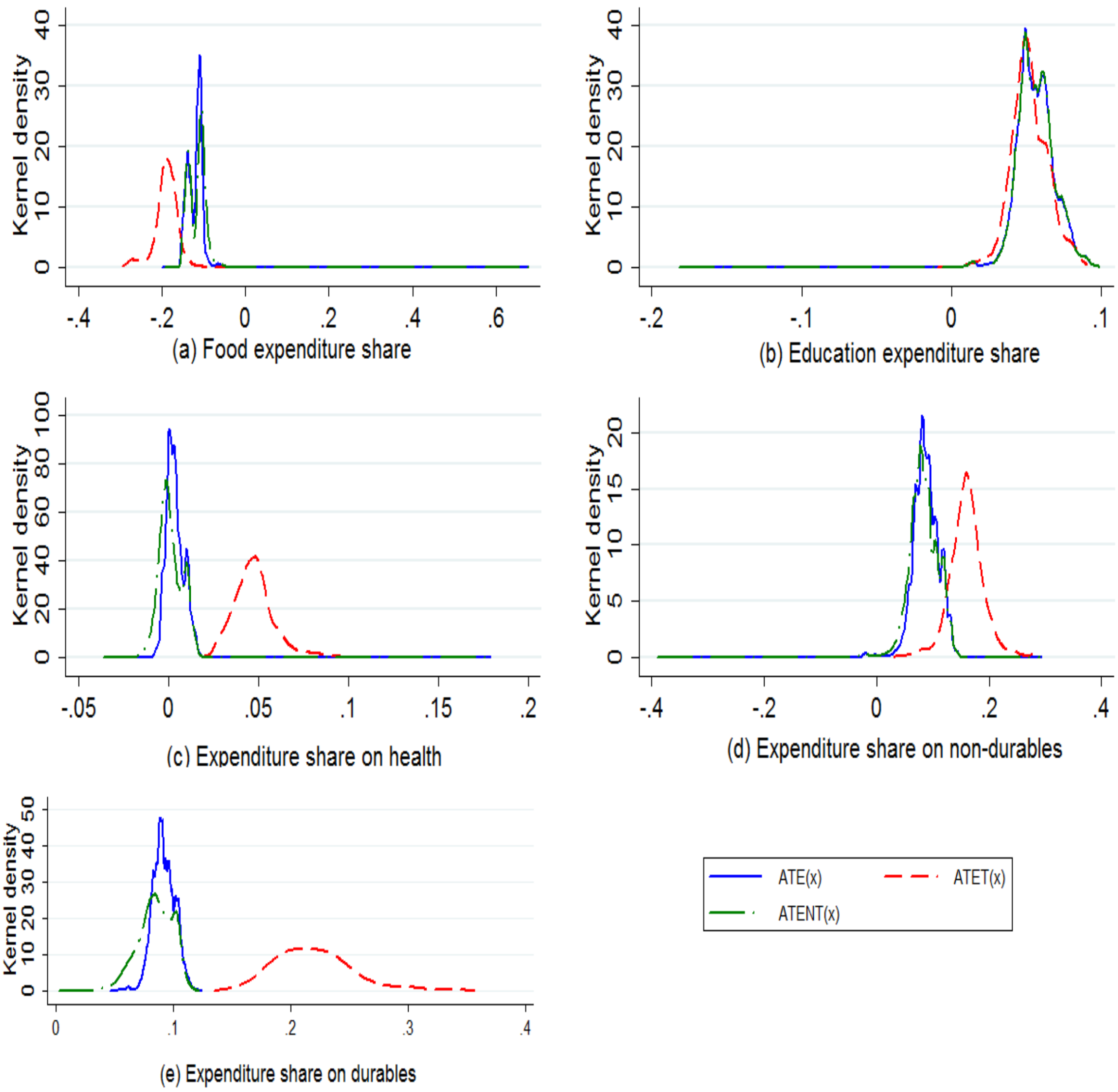

Table 4.5 estimates the marginal budget shares for each of the expenditure category defined in Table 2. The marginal budget shares indicate the response in budget shares of the individual expenditure category to a one Rupee increase in household expenditure.

Table 4.5 Estimated marginal budget shares on expenditure for remittance receiving and non-receiving households, Pakistan, 2011

Expenditure category	**Estimated marginal budget share of households receiving remittances**	**Estimated marginal budget share of households receiving no remittances**	**% change**
Food	0.411	0.450	-9.94
Education	0.037	0.028	26.08
Health	0.025	0.023	5.82
Non-durables	0.166	0.142	14.32
Durables	0.00345	0.00346	-0.04

Note: The marginal budget shares are calculated using equation (4) and taking the coefficients from Table 4.

The results show that households that receive remittances spend less at the margin on food and durables and more on education, health and non-durables. At the mean, compared to households that do not receive remittances, the households receiving remittances spend, at the margin, 10 per cent and 4 per cent less on consumption of food and durables, respectively. Moreover, the respective marginal increase in spending on education and health is 26 per cent and 6 per cent for remittances receiving households than the non-receiving households. Finally, the households receiving remittances spend, at the margin, 14 per cent more on non-durables (which includes their spending on housing) than the households with no remittances.

4.8 Conclusion

This paper has used nationally representative household income and expenditure survey data for Pakistan to investigate how the receipt of international remittances affect the average and marginal spending behaviour of the households on five different categories of goods: food, education, health, non-durables and durables. Two findings emerge.

First, expenditure share on food for households that receive remittances would have been more if the households had not been receiving remittances. Similarly, less spending on the other four categories of education, health, non-durables and durables is predicted for remittances-receiving households had they not been receiving remittances. Second, households that receive remittances spend less at the margin on food and durables and more on education, health and non-durables. At the mean, compared to households that do not receive remittances, the households receiving remittances spend, at the margin, 10 per cent and 4 per cent less on consumption of food and non-durables, respectively. Moreover, the marginal increase in spending on education is 26 per cent more for remittances-receiving households than for a non-receiving household. Finally, the households receiving remittances spend, at the margin, 14 per cent more on non-durables (which includes their spending on housing, and is thus akin to investment in physical capital) than the households with no remittances.

A key feature of these results is the likely positive impact of remittances on economic development by way of increased spending on human capital or education as well as physical capital. Remittances-receiving households appear to look at the remittance earnings as a transitory income and therefore tend to spend remittances more on investment than consumption. This finding lends support to the permanent income hypothesis. [20]

[20] A similar conclusion is drawn by Adams and Cuecuecha (2010a) in case of Guatemala.

Appendix 4A

$$\text{E}(e_{1i}|\mathbf{x}, Z_i, t_i = 1) = E(e_{1i}|u_i < q\gamma,)$$

$$= E\left(e_{1i}\middle|\frac{u_i}{\sigma_u} < \frac{q\gamma}{\sigma_u}\right)$$

$$= \sigma_1 E\left(\frac{e_{1i}}{\sigma_1}\middle|\frac{u_i}{\sigma_u} < \frac{q\gamma}{\sigma_u}\right) \qquad \text{(i)}$$

We want to have the expectation of e_{1i} given some value u_i. Given the normality of e_{0i}, e_{1i}, this is just equal to the regression coefficient,

$$E(e_{1i}|u_i) = \frac{\sigma_{1u}}{\sigma_u^2} u_i \qquad \text{(ii)}$$

Using this in equation (i) and having σ_u^2 normalized to unity, we get

$$E\left(\frac{e_{1i}}{\sigma_1}\middle|\frac{u_i}{\sigma_u}\right) = \frac{1}{\sigma_1} \cdot \frac{\sigma_{1u}}{\sigma_u^2} \cdot \left(\frac{u_i}{\sigma_u} \cdot \frac{\sigma_u}{1}\right) = \frac{\sigma_{1u}}{\sigma_1 \sigma_u} \cdot \frac{u_i}{\sigma_u} = \rho_{1u} \frac{u_i}{\sigma_u} \qquad \text{(iii)}$$

and

$$E\left(\frac{e_{0i}}{\sigma_0}\middle|\frac{u_i}{\sigma_u}\right) = \frac{1}{\sigma_0} \cdot \frac{\sigma_{0u}}{\sigma_u^2} \cdot \left(\frac{u_i}{\sigma_u} \cdot \frac{\sigma_u}{1}\right) = \frac{\sigma_{0u}}{\sigma_1 \sigma_u} \cdot \frac{u_i}{\sigma_u} = \rho_{0u} \frac{u_i}{\sigma_u} \qquad \text{(iv)}$$

σ_{0u} and $\sigma_{1u}$are the covariances of the error pairs (e_{0i}, u_i) and (e_{1i}, u_i) respectively, and, ρ_{0u} and ρ_{1u} are their respective correlation coefficients.

We now rewrite (i) as

$$\text{E}(e_{1i}|\mathbf{x}, Z_i, t_i = 1) = \sigma_1 E\left(\frac{e_{1i}}{\sigma_1}\middle|\frac{u_i}{\sigma_u} < \frac{q\gamma}{\sigma_u}\right) = \sigma_1 \rho_{1u} E\left(\frac{u_i}{\sigma_u}\middle|\frac{u_i}{\sigma_u} < \frac{q\gamma}{\sigma_u}\right)$$

$$= \rho_{1u}\sigma_1 \frac{\phi(\frac{q\gamma}{\sigma_u})}{1-\Phi(\frac{q\gamma}{\sigma_u})} = \rho_{1u}\sigma_1 \left\{\frac{\phi(q\gamma\prime)}{1-\Phi(q\gamma\prime)}\right\} \qquad (20)$$

Similarly,

$$\text{E}(e_{0i}|\mathbf{x}, Z_i, t_i = 0) = \sigma_0 E\left(\frac{e_{0i}}{\sigma_0}\middle|\frac{u_i}{\sigma_u} < -\frac{q\gamma}{\sigma_u}\right) = \sigma_0 \rho_{0u} E\left(\frac{u_i}{\sigma_u}\middle|\frac{u_i}{\sigma_u} < -\frac{q\gamma}{\sigma_u}\right)$$

$$= \rho_{0u}\sigma_0 \frac{\phi(-\frac{q\gamma}{\sigma_u})}{\Phi(-\frac{q\gamma}{\sigma_u})} = \rho_{0u}\sigma_0 \left\{\frac{-\phi(q\gamma\prime)}{\Phi(-q\gamma\prime)}\right\} \qquad (21)$$

Chapter 5 Conclusion

This thesis has examined three key aspects of economic development for Pakistan. Each of these issues in its own right has direct and indirect implications for poverty reduction in Pakistan. The contribution of agriculture in redistribution of poverty need not be reemphasized for any developing country, including Pakistan. With 43.7 per cent of labour force involved in agriculture sector, this is by far the largest employer and a key determinant of economic growth (Pakistan Economic Survey 2013-14). However, poor farming practices run the risk of impairing the long-run productivity of agricultural land which may inhibit the long-run prospects of alleviating rural poverty. With this motivation, the second chapter has attempted to re-invigorate a theoretical model for socially optimal response when externality was caused by inappropriate use of agricultural technologies along with intrinsic hydrological contamination.

Likewise, the textiles and clothing sectors play a pivotal role in Pakistan's economy. These sectors account for 8 per cent of GDP, employ about 40 per cent of industrial labour force and contribute nearly 55 per cent towards Pakistan's exports (Pakistan Economic Survey 2013-14). With such an important role to play in Pakistan's future economic growth, probing efficiencies in textiles and clothing sectors is worthwhile. An attempt has been made in chapter three of this thesis to investigate the export-efficiencies for Pakistan's textiles and clothing sectors.

Though the importance of foreign remittances in increasing the economic well-being of any economy is less debateable, it is desireable to investigate the consumption behaviour of the remittances-receiving households in Pakistan. Here again, there is a nexus of remittances with poverty reduction. Households that spend more of their marginal income from remittances on physical and human capital are more likely to prosper. Having this as the prime objective, the fourth chapter investigated the average and marginal spending behaviour of remittances-receiving households on five different categories of expenditure.

5.1 What did we find?

The second chapter demonstrated why individual optimization of agricultural production activities may lead to undesirable socially optimal outcomes when the upstream farmer did not take into account the costs he or she imposed on the downstream farmer. The scenario has been compared with the optimal decision of a social planner and it has been concluded that private optimization leads to higher concentration of contaminants in the landscape. Under the assumption that the externality flow is caused both by the increased agricultural effort and the presence of hydrological contaminants, convergence to the socially optimal steady-state path of hydrological contaminants would require the social planner to apply a composite tax on the supplier of externality. Thus, it has been concluded that in the given scenario, taxing not only the flow of contaminants but also the increased effort might be an optimal policy choice.

The third chapter estimated the impact of the abolition of the MFA on Pakistan's exports of textiles and clothing using a stochastic frontier gravity model taking into account the existing 'behind the border' constraints to increase exports. A stochastic frontier gravity model with error decomposition into the impact of 'behind the border' constraints and conventional 'statistical errors' has been used for the estimation of the gravity model. Results show that the abolition of the MFA does not have a significant impact on Pakistan's export of textiles. Also, the impact of the 'behind the border' constraints on textiles exports has been decreasing over time, which is a good sign of Pakistan's economic reform process. In contrast, the abolition of the MFA has had a significantly positive impact on Pakistan's export of clothing, but the impact of the 'behind the border' constraints on clothing exports has been increasing over time, which is not an encouraging sign of Pakistan's economic reform process. Nevertheless, the calculation of revealed comparative advantage revealed that Pakistan has been able to maintain post-MFA comparative advantage in a wide range of its textiles and clothing sub-products.

Thus, with 70 per cent of Pakistan's total exports of textiles and clothing being concentrated in the textiles sector and given the importance of the textiles sector in the GDP of Pakistan, this study emphasizes that it would be still possible for Pakistan to improve its growth further by eliminating the existing 'behind the border' constraints such as infrastructure and institutional limitations.

The fourth chapter used nationally representative household income and expenditure survey data for Pakistan to investigate how the receipt of international remittances affects the average and marginal spending behaviour of the households on five different categories of goods: food, education, health, non-durables and durables. Two findings emerged. First, expenditure share on food for households that receive remittances would have been more if the households had not been receiving remittances. Similarly, less spending on the other four categories of education, health, non-durables and durables has been predicted for remittances-receiving households had they not been receiving remittances. Second, households that received remittances spent less at the margin on food and durables and more on education, health and non-durables. At the mean, compared to households that did not receive remittances, the households receiving remittances spent, at the margin, 10 per cent and 4 per cent less on consumption of food and non-durables, respectively. Moreover, the marginal increase in spending on education has been 26 per cent more for remittances-receiving households than for a non-receiving household. Finally, the households receiving remittances spent, at the margin, 14 per cent more on non-durables (which included their spending on housing, and is thus akin to investment in physical capital) than the households with no remittances.

A key feature of these results is the likely positive impact of remittances on economic development by way of increased spending on human capital or education as well as physical capital. Remittances-receiving households appear to look at the remittance earnings as a transitory income and therefore tend to spend remittances more on investment than consumption. This finding lends support to the permanent income hypothesis.

5.2 Policy implications

The analysis in chapter 2 may entail a ‘normative’ economic statement that ‘the social planner should tax the inputs used in agriculture in order to internalize the external costs associated with the (inappropriate) use of these inputs.’ Though at this stage a ‘positive’ statement cannot be made as the findings have not been validated with factual data, one obvious policy implication is the realization of impact poor agricultural practices may have on the long-run poverty and food security of rural households in general, and the overall economic growth of Pakistan in particular. The implication is of particular significance for Pakistan, where agriculture contributes 21 per cent towards GDP and employs 43.7 per cent of labour force that produces food not only for its own sustenance but also for the rest of the nation.

The findings of chapter 3 have even stronger policy implications. Having a narrow export base with 55 per cent of total exports concentrated in textiles and clothing commodities, Pakistan can hardly afford to have low export-efficiencies in these sectors. Moreover, having observed that a significant variation in textiles and clothing exports (88 per cent for textiles and 25 per cent for clothing) is due to institutional barriers, there is a need to improve the institutional arrangements for boosting textiles and clothing exports.

5.3 The way forward

Like any typical research, this thesis is not void of shortcomings. While chapter 2 proposes a theoretical model of agricultural externality, a bigger challenge is empirical validation of the model. If on one hand data issues impedes the empirical validation of the model, on the other hand, the model has inbuilt endogeneity between the state variable of hydrological contamination and the control variable of effort. Any future empirical validation exercise will have to address this econometric issue also.

The third chapter concluded that Pakistan can improve its economic growth by improving exports' efficiency and by eliminating the existing 'behind the border constraints' such as infrastructure and institutional limitations. However, the analysis did not identify the key institutional factors causing inefficiencies in export of textiles and clothing sectors. A preferable empirical approach would be to model exports and inefficiency simultaneously using a two-equation model. However, due to data limitations such analysis could not be undertaken in this study.

The fourth chapter examines the average and marginal spending behaviour of remittances-receiving households in Pakistan. While the analysis has been carried out duly catering for presence of selection bias due to unobserveale heterogeneity, the estimates only give an average response. Do the findings hold for the household at the upper and lower quintiles? Answering this question will probably require some semi-parametric analysis.

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