

## Product Quality, Informality, and Child Labour

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CESIFO WORKING PAPER NO. 3537  
CATEGORY 4: LABOUR MARKETS  
JULY 2011

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## Abstract

This paper studies the interactions between the structure of product demand, relative wages, and the allocation of economic activity across two sectors. The agrarian sector produces a homogeneous good and consists of informal firms employing adults and children. The modern sector produces a quality-differentiated product: high-quality varieties are produced by formal firms which employ only adult labour, whereas low-quality varieties are produced by informal firms which employ child labour as well. Differences in tastes and incomes across households generate demand for both high-quality varieties and the low-quality varieties. We find that stricter enforcement of child-labour regulations and increases in minimum wages can have beneficial effects as far as the incidence of child labour and the size of the formal sector are concerned. However, since these policies have undesirable welfare effects among segments of wage-earning households, they may not garner the necessary political support.

JEL-Code: O110, O170, E260.

Keywords: child labour, informality, product quality, welfare.

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We wish to thank Lex Zhao for many helpful discussions, as well as Bogazici University (CEE), Kobe University (RIEB), and the University of Munich (CES), for their hospitality while various versions of the paper were developed. We also wish to thank Panos Hatzipanayotou and seminar participants at AUEB and Bogazici University for helpful comments and suggestions.

## 1. Introduction

The purpose of this paper is to use some important building blocks of the literature on child labour and the informal economy to develop a model which uncovers some new channels through which some widely discussed policy interventions in the child labour literature can be analysed. The distinguishing feature of our approach is the interaction between the structure of product demand, relative wages, and the allocation of economic activity across the formal and informal sectors.

The incidence of child labour has been recognised as one of the most pressing economic and social issues in developing countries; e.g. ILO's (1973) Convention on the Minimum Age for admission to Employment and Work. This recognition was followed by a number of international initiatives and policy interventions. These took many forms, and they ranged from information campaigns, to income replacement programs, flexible schooling programs, reintegration projects, restrictions on employment, and conditional cash transfers. The information campaigns include the *World Day against Child Labour (set on June 12)*, labeling campaigns such as *Rugmark*, which labels hand-knit carpets as "child labour free", and the "*Red Card*" which takes place during international football competitions to inform the public on child labour issues with the aim of fostering the emergence of a world movement against child labour. Among the policy initiatives are conditional cash transfer programs such as Brazil's *PETI (Programme for the Eradication of Child Labour)*, whose main feature is the after-school programme, *Jornada Ampliada*, which is obligatory for children benefiting from the grant. The basic idea is to help reduce child labour by simply keeping the children at school twice as long, thereby limiting the time available for work (ILO, 2006).

At the same time the economic literature was making great strides in understanding the causes and consequences of child labour as well as alerting policymakers to the dangers of bland policy interventions. Following on the influential contributions of Basu and Van (1998), and Baland and Robinson (2000), the research effort has been extended in various directions. The causes and consequences of child labour have been analysed, *inter alia*, in relation to: minimum wage legislation and labour standards (e.g. Maskus (1997), Basu (2000)); trade and globalization (Ranjan, 2001; Jafarey and Lahiri, 2002;

Edmonds and Pavnik, 2005; Dinopoulos and Zhao, 2007); fertility and human capital accumulation (Chaudhuri, 2000; Fan, 2002; Brown et al., 2002; Doepke and Zilibotti, 2005); and income distribution (Swinnerton and Rogers, 1999; Rogers and Swinnerton, 2004).

One characteristic of child labour is the fact that the phenomenon of child labour is stronger in countries with large informal sectors. In most developing economies the contribution of the informal sector to the national income is very important, and child labour occurs almost exclusively in the informal sector – usually, in simple units with simple technology and little capital equipment (Galli, 2001). Most influential studies in the child labour literature do not take into account the interactions between child labour and the allocation of economic activity between the formal and informal sectors. In the few studies that explicitly take account of the informal sector, it is assumed that it employs only children and produces either an identical good as the formal sector (Dessy, 2000; Dessy & Pallage, 2001), or produces an intermediate good used by formal-sector firms to produce the single final good (Maskus, 1997). However, the assumption that the informal sector employs only child labour is hardly convincing given the large size of informal output in many developing countries. Moreover, such a setting does not allow for (adult) inter-sectoral labour mobility between the formal and informal sectors, and it underestimates the role of *informal sector trap* in the incidence of child labor.

However, there are studies (e.g., Jafarey and Lahiri, 2002; Dinopoulos and Zhao, 2007) that do take into account the interactions between child labour and the inter-sectoral allocation of economic activity. (Although the authors do not explicitly model one of the sectors as the informal sector, one could easily attach such an interpretation to their models.) These studies have been concerned with the effects of trade sanctions and globalization on the incidence of child labour. Jafarey and Lahiri (2002) have constructed a two-sector model in which the existence of borrowing constraints interacts with educational choices. Children and unskilled adults are employed in the production of the export good, while skilled adults (which children can become after receiving education) produce the imported good. The authors find that trade sanctions -which reduce the relative wages of unskilled – can lead to an increased supply of child labour, and that the possibility of such an outcome increases with the

severity of credit constraints. The reason for this outcome is that a reduction of the incomes of very poor families (headed by unskilled workers) induces credit constrained parents to increase the amount of time spent by their children in labour and reduce that spent on education. Thus, the incidence of child labour in this model is shaped by factors influencing the supply of child workers.

In contrast, in the model developed by Dinopoulos and Zhao (2007) the focus is on the demand determinants of child labour – the supply of child labour is exogenous. They have constructed a specific-factors model of a small open economy, in which three factors (skilled and unskilled adult labour and child labour) produce two homogeneous goods. The first good is produced in the “modern” sector, using sector-specific capital and skilled adult labor. The second good is produced in the “agrarian” sector, using skilled labour and unskilled (child and adult) labour. Efficiency wages are used by firms in the modern sector to induce higher effort and labour productivity, whereas the agrarian sector firms offer nutritional efficiency wages to child labourers. This set up allows the authors to examine the effects of various trade and domestic policies on the incidence of child labour by taking into account the influence that these policies may have on the inter-sectoral allocation of economic activity. This is important for the incidence of child labour since, by assumption, children are employed only in the agrarian sector.

In the present paper we analyze further the demand-side determinants of child labour, especially its interaction with the informal sector. For this purpose, we find that the assumption that child labour is concentrated only in one sector (agrarian) is restrictive. After all, many children are employed in developing-world cities not only as street vendors and shoe polishers but in manufacturing, construction, and trade-related activities as well. For example, Edmonds (2007) reports that in some countries (e.g. Pakistan, Sri Lanka, Turkey) there are more children employed in manufacturing than in agriculture, forestry and fishing, while in most countries the manufacturing sector remains a significant part of the total employment of children. (Adding the children employed in construction, hotels, restaurants, and trade-related activities, makes the number of children employed in non-agrarian activities even a more important component of total child employment). Another important characteristic of non-agrarian sector child labour is that it is concentrated in the informal sector. According

to ILO (2006), “most children work in the informal sector, without legal or regulatory protection”. Buchmann (2000) points out that in addition to laws limiting the employment of children in the formal sector,<sup>1</sup> there are other factors minimizing the number of children working in formal workplaces, such as the presence of adult trade unions and the relatively high education, skill and physical strength demanded by most formal-sector employers.

In order to capture these aspects, we consider a closed economy consisting of two perfectly competitive sectors. One of them produces a homogeneous good, and the other produces a vertically- differentiated product. We identify the homogeneous-good sector with agriculture, and assume that its output is produced by informal firms employing adult and child workers. The production of the vertically-differentiated product is segmented according to quality: high-quality varieties are produced by firms in the formal sector, whereas low-quality varieties are produced by informal-sector firms. This assumption is based on the “quality dualism” framework of Banerji and Jain (2007). They argue that in many developing countries, while (urban) informal firms produce goods and services that are also produced by formal firms, there is a *quality gap* between the outputs of two sectors, with formal firms having comparative advantage in the high-quality variety and the informal firms in the low-quality substitute. Although Banerji and Jain (2007) abstain from child labour issues, we introduce them by assuming that formal firms employ only adult labour, while informal firms employ both adult and child labour. Thus the model involves three “sectors”: an urban formal sector producing the high-quality variety of the vertically-differentiated product, and two informal sectors – one of which is producing the low-quality variety of the vertically-differentiated product, and the other being the agrarian sector.

Our stronger connection with the child labour literature comes from following Basu and Van’s (1998) strong connection between family living standards and child labour: the leisure of children is treated as a luxury good, which parents cannot provide at low

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<sup>1</sup> In many countries these laws are not vigorously enforced. For example, the Venezuelan National Children's Institute calculated that the formal sector employs almost 20 percent of child labourers (UNICEF, 1996).

level of income (the *luxury axiom*).<sup>2</sup> Following Emerson and Souza (2003) we introduce a simplified static version of the dynamic child labour trap (the *informal sector trap*). In our model, adults working in the informal (urban or agrarian) sectors receive the market clearing wage and send their children to work, whereas those working in the formal sector receive a binding minimum wage and can afford to send their children to school. This supply structure is complemented with a preference structure which, due to differences in tastes and income across households, generates demand for both the high-quality variety produced by formal firms, and the low-quality variety produced by informal firms.

We focus on the effects of two policy interventions: a stricter enforcement of child labor regulations (*CLR*) and changes in the level of the minimum wage. We note that the most common policy prescription with regard to child labor issues is the imposition of a ban on child labour. The desirability of this policy is contested in the theoretical literature (Soares, 2010). For example, banning child labour could be an efficient interventionist benign policy in economies with multiple equilibria, while in the case of a unique equilibrium (which is most likely in poor countries) it can result in a rise in child employment (e.g., to Basu and Van, 1998; Dessy and Pallage, 2001). Moreover, there is no available empirical evidence from low income countries on its effectiveness (Edmonds, 2007).

We examine the policy implications of a tighter enforcement of *CLR* since this is a more realistic policy scenario than a total ban in the context of developing economies (due to high social and monitoring costs). Our results suggest that a more regulated child labor market could be desirable; it can reduce both the employment of children and it can increase the welfare of households working in the informal sector. The explanation of our results lies on the switch in demand from low-quality and informal-sector produced varieties to high-quality, formal-sector produced varieties that a stricter enforcement of child labour regulation generates. In our model, stricter enforcement decreases child labour supply, thus inducing an increase in informal sector wages (of

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<sup>2</sup>Basu and Van (1998) are able to generate multiple equilibria in their model: there exists a “bad” equilibrium where child labour emerges and the adult wages are too low and a “good” equilibrium where there is no child labour and adult wages are high. We preclude the emergence of multiple equilibria.

both adults and children) and in the price of the low-quality good. This in turn switches household demand towards the high quality good (formal sector), implying a “demand-pull” reallocation of economic activity from the informal to the formal sector. As a result, child employment is reduced, a higher proportion of households are paid at the minimum wage, and the market-clearing wage is increased.

Nevertheless, the policy harms some segments of the population. Adults, who were working in the formal sector before stricter *CLR* was enforced, and which continue to consume the low-quality *VDP*, will experience a fall in welfare as the price of the low-quality variety will increase due to the rise in the informal sector’s wage. The same will also be true for all households remaining in the informal sector since the rise in informal wages will be offset not only by the commensurate rise in the price of the low-quality variety, but also by the child’s labour supply. These adverse consequences of stricter enforcement of *CLR*, explains why the politico-economic equilibrium in many countries is not conducive to their implementation. (However, in section 4, we discuss some ways in which the implementation of stricter *CLR* can ameliorate some of these effects).

Although the use of the minimum wage as a policy instrument to achieve desired distributional goals has been widely discussed in the informal sector literature (Fizsbein, 1992; Sagat 2001; Bird and Manning 2002; Lemos, 2004), it has received only scant attention in the child labour research field. One important exception is Basu’s (2000) paper. He shows that the common presumption that a rise in the minimum wage will reduce child labour supply (since households will be less poverty-constrained, and thus prefer to send their children to school -i.e. the *luxury axiom*) may not always hold. Our model identifies a mechanism that may run in the opposite direction. We argue that an *income effect* generated by an increase of the minimum wage may differentiate the policy outcomes. The intuition behind these results is simple and – though formally different – follows Fizsbein’s (1992) demand approach: as formal-sector households become richer, they may switch their demand toward the high-quality variety. The subsequent expansion of formal economic activity may induce positive outcomes concerning not only a reduction in children’s employment (as formal employment increases, fewer parents send their children to work) but also due to rising wages in the informal sector. Although one can not be certain whether the channel



identified by Basu (2000) is empirically stronger than the one identified here, we note that the limited empirical evidence we have in this regard does not contradict our result. For example, Wahba (2006) finds that in Egypt, a 10% increase in the illiterate male market wage decreases the probability of child labour by 22% for boys and 13% for girls. Given the strong positive correlation that exists in the data between minimum wages and the wages of the unskilled, this evidence provides some support for our channel.<sup>3</sup>

In the rest of the paper we first lay out the model, and then we proceed with the policy analysis. In addition to the effects of stricter enforcement of child labour regulations and increases in minimum wages, we also examine the effects of changes in the productivity of the agrarian sector, and of changes in labour supply.

## **2. The model**

We consider the case of a small closed economy consisting of two perfectly competitive sectors. One of them produces a homogeneous good, and the other produces a vertically-differentiated product. We identify the homogeneous-good sector with agriculture, and assume that its output is produced by informal firms employing adult and child workers. The production of the vertically-differentiated product (VDP) is segmented according to quality: high-quality varieties are produced by *formal* firms (indexed by  $F$ ), whereas low-quality varieties are produced by *informal* firms (indexed by  $IN$ ) employing both adults and children. For ease of exposition in what follows we refer to the sector producing the vertically-differentiated product (VDP) as the *modern* sector, and the agricultural sector as the *agrarian* sector. We will reserve the adjective “informal” only for (that subset of) modern-sector firms, with the understanding that *all* producers in the agrarian sector are informal.

### **2.1 Supply relationships**

#### **2.1.1 Agrarian Sector**

The agrarian good is produced with the use of labour and of a factor in fixed supply. The factor in fixed supply is provided by landowners (e.g. land), and we normalize its supply to unity. The labour used by the agrarian sector is denoted by  $L_A$ , and it

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<sup>3</sup>However, this evidence can be consistent with Basu’s (2000) model as well.

represents the labour provided by adult and child workers in effective terms. Following standard practice in the literature (e.g. Basu and Van, 1998; Doepke and Zilibotti, 2005; Dinopoulos and Zhao, 2007) we assume that child workers can do whatever adult workers can do, but their productivity is only a fraction  $b$  ( $0 < b < 1$ ) of adult workers' productivity. This assumption implies that unless adult and child workers are paid the same wage rate per *effective* unit of labour, agrarian sector producers will not employ both types of workers. We thus assume that if adult workers' wage rate is  $W_{IN}$ , children receive a wage rate  $W_C$ , such that

$$W_C = bW_{IN}. \quad (1)$$

The agrarian sector's production function is:

$$A = BL_A^\alpha. \quad (2)$$

Parameter  $\alpha$  ( $0 < \alpha < 1$ ) indicates the presence of diminishing returns, and  $B$  is an index of agrarian-sector productivity. Using the agrarian good as the numeraire ( $P_A=1$ ), the profit-maximizing demand for effective units of labour is

$$W_{IN} = \alpha BL_A^{\alpha-1}. \quad (3)$$

The resulting aggregate profits of the sector are equal to:

$$\pi_A = (1 - \alpha) BL_A^\alpha. \quad (4)$$

We assume that profits are equally distributed among the landowners, whose number is equal to  $T$ .

### **2.1.2 The Modern Sector**

The modern sector is essentially made up of two distinct sub-sectors: the formal sector and the informal sector. What distinguishes the two sectors is that the formal sector produces a high-quality variety of the VDP, whereas the informal sector produces a low-quality variety. The VDP is produced with the use of labour only. Quality is measured by an index  $Q$ , and there is complete information regarding the quality index. We assume that there exists a "cottage" technology which is available to all for producing low-quality varieties of the VDP, and a modern technology which allows the production of high-quality varieties. Low-quality varieties are defined as those for which  $Q \leq \bar{Q}$ , whereas high-quality varieties are identified with  $Q \geq \bar{Q}$ . Firms that have access to the technology which allows the production of high-quality varieties belong to the formal sector, whereas the rest of the firms are informal. We may think that the

production technology is such that formal firms have access to excludable public inputs which allows them to produce the high quality good at lower cost than informal firms (e.g., access to electricity at subsidized prices). Moreover, this categorization of firms is motivated by the fact that consumers of high-quality, high-priced items are more likely to demand after-sales services (guarantees, repairs, etc) to which only formal sector firms can credibly commit to (and be legally responsible).

In order to have informal firms able to produce the low-quality variety at a lower cost than formal firms, we need to assume that the difference in productivity between formal and informal producers is small when quality is low - since then any wage advantage of informal firms (explained below) could offset their productivity disadvantage (see, Flam and Helpman, 1987; Eswaran and Kotwal, 1997; Malley and Moutos, 2001, for applications of this idea in the context of international trade). As long as this productivity disadvantage of the informal producers gets larger as quality increases, there will be a quality threshold after which formal producers will have lower costs than informal ones. Our assumption that the modern technology is available only to a subset of firms provides a stark manifestation of this idea.<sup>4</sup>

This simple formulation adopted here, captures two fundamental features of a typical dual developing economy regarding (i) the quality gap between sectors and (ii) the limited access of the informal sector to public services. These features have been extensively documented in the literature. Banerji and Jain (2007) quote many studies documenting the existence of quality gaps: for example, Myint (1985) claims that typical features of developing countries are "... large factories producing more expensive and better quality products and small handicraft industries producing cheaper and lower quality products", whereas Livingstone (1991) in his discussion of the informal sector in Kenya, says that "... in a market dominated quantitatively by low-income consumers, [informal sector producers] offer cheap and 'appropriate' goods." The goods and services consumed by low-income consumers "... serve similar purposes at a much lower price - informal sector taxis, local beer instead of canned beer ... and less hygienic eating houses and food kiosks instead of modern hotels." The lack

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<sup>4</sup>Rausch (1991) was the first to formalize the idea that the inferior technological capability of informal firms is the reason for their inability to compete on an equal footing with formal firms, thus forcing them to operate in the informal sector where the ability to avoid some costs related to regulation (taxation, minimum wages) allows them to survive.

of access by the informal sector to public services is particularly acute with respect to the legal and judicial system and the police, as well as to the capital markets since informal businessmen cannot exercise full property rights over their capital and product (Loayza, 1996), an implication of which is a rise in the cost of their capital (De Paula and Scheinkman, 2011).

The high-quality variety is produced (in the formal sector) by adult workers only. This assumption may be thought of in two ways. First, as a direct consequence of our definition of *formality*; i.e. formal firms obey all regulations – including the (albeit lax) regulations against child labour. Second, and more importantly, as an expression of the idea that higher quality goods require more human capital, which adults have but children lack (e.g., Copeland and Kotwal, 1996; Banerji and Jain, 2007). In contrast, low-quality varieties can be thought of as being produced with a standardized technology which does not require much human capital; thus, for informal firms we make use of the *substitution axiom* of Basu and Van (1998), and we assume that both adult and child workers are employed, and that they are (perfectly) substitutable in the same way as in the agrarian sector.

Formal firms face labour market regulation not only with respect to the non-use of child workers, but also with respect to having to pay a (binding) minimum wage  $W_M$ . (Note that a legally binding minimum wage, which is independent of the age of the worker, is another reason why formal firms would not be willing to hire the lower-productivity child workers.) In addition to labour market regulations, formal firms have to incur a cost,  $F$ , per physical unit of output. We may think of this cost as the “price of formality”, and it can represent either the burden of various taxes<sup>5</sup> imposed on formal firms, or the costs of complying with various environmental, health, or work-safety regulations.<sup>6</sup> Informal firms do not comply with any of the above regulations, and pay

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<sup>5</sup>We abstain from any explicit treatment of issues relating to the government budget constraint. In principle, we could have the government use its tax proceeds to finance various cash-transfer programs to households which are conditional on school attendance.

<sup>6</sup>We may think that  $W_M$  and  $F$  are indexed (or, linearly related) to the price of the homogeneous (the *numeraire*) good. The indexation of the minimum wage on the price of the agrarian good can be due to explicit or implicit government-set indexation schemes, e.g.,  $W_M = \lambda P_A = \lambda$ ; we abstain from a consideration of the process by which the minimum wage is set, and we will simply consider changes in  $W_M$  as resulting from changes in the indexation parameter  $\lambda$ .

their workers the market-clearing wage rate -  $W_{IN}$  and  $bW_{IN}$ , for adult and child workers, respectively. We assume that the minimum wage rate,  $W_M$ , is higher than the informal wage rate,  $W_{IN} < W_M$ .

Following Flam and Helpman (1987) and Banerji and Jain (2007) we assume that average costs depend on quality and that, for any given quality level, average cost is independent of the number of physical units produced. We write the average cost functions (as functions of quality) for formal and informal firms as,

$$AV(Q_F) = P(Q_F) = W_M Q_F + F \quad (5)$$

$$AV(Q_{IN}) = P(Q_{IN}) = W_{IN} Q_{IN} \quad (6)$$

with  $P(Q_F) > P(Q_{IN})$  given that  $W_M > W_{IN}$  and  $Q_F > Q_{IN}$ .

This specification of average costs implies that as quality increases, more units of labour are required to produce each physical unit of the VDP product. This assumption is consistent with the fact that increases in quality – for a given state of technological capability – involve the employment of a larger number of personnel not only for the production of a higher number of features attached to each good that directly absorb labour, but also to the development and refinement of these features as well.

## 2.2 Households

The economy is populated by a fixed number of landowners ( $T$ ) and identical working households ( $L$ ). Each household consists of one adult member and one child. All adult members are endowed with one unit of effective labour, which they offer inelastically<sup>7</sup>. Children are endowed with  $b$  ( $b < 1$ ) units of effective labour. We follow the literature's standard assumptions about the altruistic and paternalistic behavior of the household (e.g. Basu and Van, 1998; Baland and Robinson, 2000), i.e., we assume that the adult member makes all the economic decisions including the time allocation decision for the child. Following the *luxury axiom*, the working households are distinguished into two categories regarding their wage incomes and their subsequent decisions on child employment. Adult members who are engaged in the formal sector and paid at the binding minimum wage ( $W_M$ ) can afford to send their children to school or keep them at

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<sup>7</sup> Although there is no empirical evidence on the elasticity of labour supply in developing countries, the assumption that is inelastic seems reasonable for these economies which are characterized by the lack of social security nets and the widespread poverty.

home. On the other hand, adult members who work either in the informal or the agrarian sector and earn the competitive wage ( $W_{IN}$ ) are forced to consider sending their children to work. Thus, the minimum wage in our setting plays the same role as the *subsistence level* of Basu and Van (1998). The assumptions that the minimum wage level (fixed by the government) can guarantee the basic goods basket to formal workers while the wage gap is large enough meaning that the fully flexible wage cannot satisfy even the subsistence needs of informal/agricultural households are consistent with the empirical evidence in developing economies<sup>8</sup>. For simplicity we assume that the landowning households do not supply any labor, neither adult nor child.

Given our desire to focus on demand issues, we abstain from a full treatment of child labour supply decisions and we simply assume that the economy is subject to a child labor regulation (*CLR*) whose level of strictness  $s \in (0,1)$  affects directly aggregate child labor supply, which, in effective terms is equal to  $(1-s)b$ . The case of a complete enforcement of a ban on child labor applies when  $s \rightarrow 1$ . This implies that if *CLR* is strict and well enforced the effective labor force participation of children would be small. This interpretation of *CLR* implicitly places the burden of complying with the regulation on households rather than firms (see, Basu, 2000, for an analysis of the case in which firms are fined for employing children). We may think of various ways in which households may be induced to comply with *CLR*. An indirect way to make households comply is to make school attendance (up to a certain age) obligatory and use various incentive/discipline schemes to induce parents to send their children to school. Providing free school meals, and in-school medical care and medicines is one way to do this. The *Mid-Day Meal Scheme* in India involves millions of families who can feed their children by sending them to school, and keeping them out of child labour. Vermeersch and Kremer (2005) have evaluated a program providing meals to children attending preschool in Kenya. They found that school participation was 30 percent greater in schools with a free breakfast, than in comparison schools without free breakfast. Making the provision of vital social services to households dependent on school attendance is another way. Examples of such programs are the *PROGRESA*

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<sup>8</sup> A set of comparative workforce development studies in five countries – Egypt, El Salvador, India, Russia and South Africa provide useful data on the wage gap between sectors (NALEDI, 2003). El Mahdi and Amer (2004), result in a large gap between formal and informal real wages in Egypt measured at two points in time (1988 and 1998) and for both sexes.

programme in Mexico, the *Program Familias en Acción* in Colombia, and the *PRAF* in Honduras, which offer cash transfers, nutritional supplements, and preventive health care as well as educational programs about health and hygiene conditional upon school attendance.

Attending school does not prevent children from working after-school hours, but it does reduce the hours that they can work. Moreover, if school attendance is not only obligatory up to a certain age but also until a child achieves the learning required by each level of education (e.g., elementary school), devoting most of the child's after-school hours to work may imply that the child has to stay in school for more years, thus reducing the child's lifetime labour supply. The diligence with which teachers and school inspectors are expected to carry their duties will be a key determinant of the effect of such policies on child labour supply.<sup>9</sup> We summarize the influence of all the above named factors in the variable  $s$ .

Following Flam and Helpman (1987) we treat the homogeneous good as being divisible, while the VDP is assumed to be indivisible and households can consume only one unit of it. A convenient characterization of household preferences over the consumption of goods (for either landowners or working households) is given by the following utility function for household  $i$ :

$$U_i = \theta_i \ln Q + \ln A_i . \quad (7)$$

In equation (7),  $Q$  stands for the quality (either  $Q_F$  or  $Q_{IN}$ ) level of the VDP,  $A_i$  is the quantity of the homogeneous good (agricultural) consumed by agent  $i$  and  $\theta_i$  is a parameter which differentiates the intensity of preferences among households for the quality level of the VDP.

In order to be able to examine the incidence of various policies on child labor and informality while at the same time to be consistent with the empirical observations on the economic environment of developing economies (regarding the large wage gap), we formulate the purchasing behavior as follows: We assume that all households working in the informal /agrarian sectors have the same preferences, with taste parameter  $\theta_{IN} = 1$

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<sup>9</sup>Changes in the obligatory years of education (e.g., from 6 to 9 years) or in the level of educational achievement that a child must achieve (e.g., elementary school graduate) can also affect the number of hours/years that children work.

and always decide to consume the low-quality, informally-produced, VDP ( $Q_{IN}$ ). The budget constraint of these households is,

$Y_{IN} = W_{IN} + b(1-s)W_{IN} = A_{IN} + P(Q_{IN}) = A_{IN} + W_{IN}Q_{IN}$ , where,  $Y_{IN}$  is the income of the household, consisting of the adult's wage,  $W_{IN}$ , and the child's wage income,  $(1-s)bW_{IN}$ ,  $A_{IN}$  is the consumption of the homogeneous good, and  $W_{IN}Q_{IN}$  is the price of the low-quality variety offered by informal firms. Given the above preferences the utility maximizing demand for the homogeneous good  $A_{IN}$  is

$$A_{IN} = W_{IN} + b(1-s)W_{IN} - W_{IN}Q_{IN} . \quad (8)$$

Figure 1 displays the choices of a household receiving the informal wage. The two quality levels of the VDP are depicted on the horizontal axis, and the quantity of the homogeneous good (as well as household income given that  $P_A = 1$ ) is depicted on the vertical axis. The household's income determines the budget constraint, which, since only two quality levels of the VDP are available, comprises just of points 1 and 2.

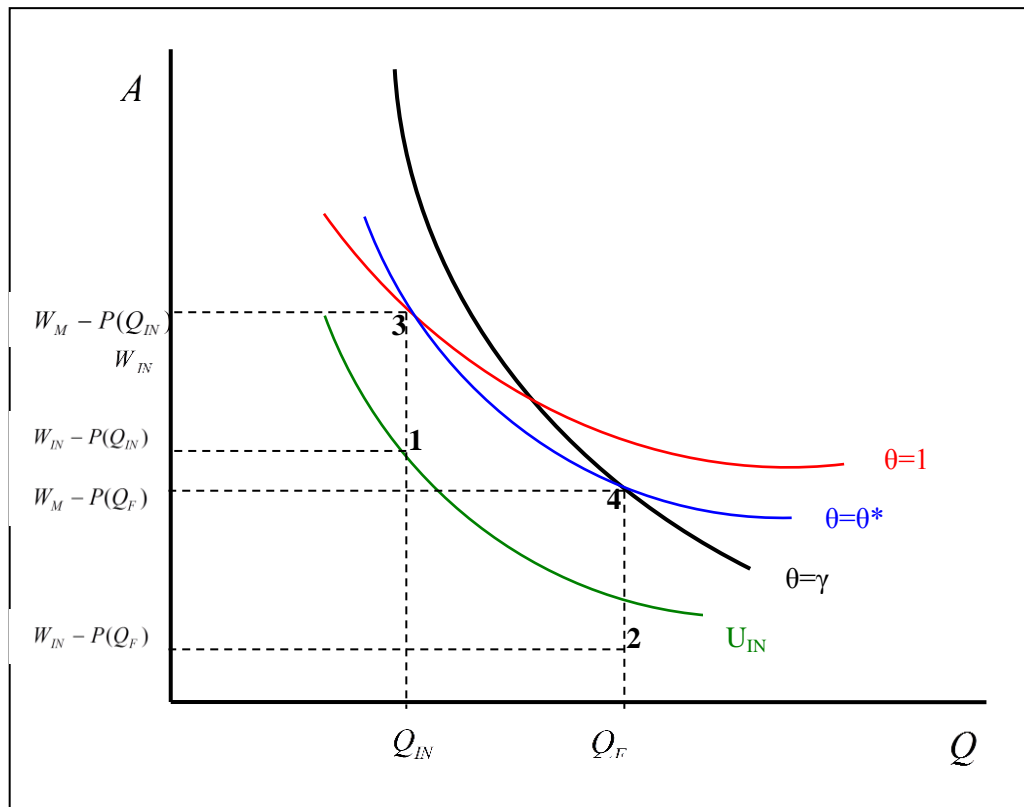


Figure 1: Consumption behavior of formal-sector and informal-sector households.



Low-income households select between these points the one giving them the highest utility, which in Figure 1 is point **1** - the one associated with consumption of the informally-produced, low-quality variety of the VDP.

For households earning the minimum wage we assume that there are differences in their intensity of preferences over the quality level, implying the willingness to pay for the high quality  $Q_F$ . For this income group we assume that the taste parameter is distributed according to a continuous uniform distribution in the interval  $[1, \gamma]$  and its cumulative density function is given by:

$$D(\theta) = \begin{cases} 0 & \text{for } \theta < 1 \\ \frac{\gamma - \theta}{\gamma - 1} & \text{for } 1 \leq \theta \leq \gamma \\ 1 & \text{for } \theta > \gamma \end{cases} \quad (9)$$

For simplicity, and without much loss of generality, in what follows we assume that changes in the employment status of households will be associated with changes in their preference structure; i.e., households switching from informal to formal employment will acquire the preference traits (through peer pressure or social osmosis) of formal-sector households.

In Figure 1 we depict the formal-sector households with income  $Y_F (= W_M)$ ; their budget constraint comprises of points **3** and **4**. Among these households, the one with the highest value of  $\theta (= \gamma)$ , has a map of "steep" indifference curves (one of which is denoted by  $\theta = \gamma$ ) and achieves maximum utility by consuming bundle **4**. As a result, the utility maximizing demand for the homogeneous good is,

$$A_F^H = W_M - P(Q_F) = W_M - (W_M Q_F + F). \quad (10)$$

To ensure that this household purchases both goods, we assume that  $W_M(1 - Q_F) > F$ , which can be the case only if  $Q_F < 1$ . In contrast, the household with the lowest value of  $\theta$ , is represented by indifference curve  $\theta = 1$ , and chooses to consume bundle **3**, i.e., the informally-produced good. The demand for good A by this household is,<sup>10</sup>

$$A_F^L = W_M - P(Q_{IN}) = W_M - W_{IN} Q_{IN}. \quad (11)$$

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<sup>10</sup>Note that no further restrictions are required to ensure positive demands for both goods in this case.

Note that no further restrictions are required to ensure positive demands for both goods. Equations (10) and (11) imply that for a formal-sector household with  $\theta = \theta_i$ , the indirect utility function takes the form:

$$V_F^H = \theta_i \ln Q_F + \ln(W_M - W_M Q_F - F), \quad \text{if it consumes the high-quality good} \quad (12)$$

$$V_F^L = \theta_i \ln Q_{IN} + \ln(W_M - W_{IN} Q_{IN}), \quad \text{if it consumes the low-quality good} \quad (13)$$

Let  $\theta^*$  denote the value of  $\theta$  for which a household is indifferent between consuming one unit of quality  $Q_F$  at price  $P_F$  and one unit of quality  $Q_{IN}$  at price  $P_{IN}$ . For this household it must hold that,  $V_F^H(W_M, Q_F) = V_F^L(W_M, Q_{IN})$ , which implies:

$$\theta^* \ln Q_F + \ln(W_M - W_M Q_F - F) = \theta^* \ln Q_{IN} + \ln(W_M - W_{IN} Q_{IN}) \quad (14)$$

Solving equation (14) for  $\theta^*$  we find,

$$\theta^* = \frac{\ln(W_M - W_{IN} Q_{IN}) - \ln(W_M - W_M Q_F - F)}{\ln Q_F - \ln Q_{IN}} \quad (15)$$

A formal-sector household with  $\theta = \theta^*$  is depicted in Figure 1 as possessing the indifference curve passing from points **3** and **4**.

Using the specification of the uniform distribution adopted above, we find that the number of formal-sector households which consume the high-quality variety (i.e., those with  $\theta \geq \theta^*$ ) is equal to  $\left(\frac{\gamma - \theta^*}{\gamma - 1}\right) L_F$ , where  $L_F$  is adult employment (in both absolute and efficiency units) in the formal sector.

By assumption, landowners earn more than minimum-wage earners, so that they always choose to consume the high quality good produced in formal sector, implying that the consumption of homogeneous good  $A_T$  given by

$$A_T = \frac{\pi_A}{T} - P(Q_F) = \frac{(1 - \alpha) B L_A^\alpha}{T} - (W_M Q_F + F), \quad (16)$$

where  $\frac{(1 - \alpha) B L_A^\alpha}{T}$  is the profits accruing to each of the  $T$  landowners.

### 2.3 Equilibrium Relationships

We start by describing the allocation of workers across sectors. We assume that adult workers are mobile across sectors and, thus, should they fail to find employment in the formal modern sector at the minimum wage, they offer their services in the informal (modern plus agrarian) sectors at the market clearing wage. Child workers can find employment only in the informal sectors.

The demand for labour by formal-sector firms,  $L_F^D$ , is induced by the demand for the high-quality varieties registered by two groups of households. First, the proportion of formal-sector households purchasing the high-quality good ( $= \left( \frac{\gamma - \theta^*}{\gamma - 1} \right) L_F$ ), and second, by the landowning households. Thus,

$$L_F^D = \left( \frac{\gamma - \theta^*}{\gamma - 1} \right) L_F Q_F + T Q_F . \quad (17)$$

The demand for labour (in effective units) by informal firms in the modern sector is induced by the consumption of the low-quality variety of the *VDP* by households (working) in both the formal and informal sectors. The number of formal-sector households consuming the low-quality variety is equal to  $\left( \frac{\theta^* - 1}{\gamma - 1} \right) L_F$ . The number of informal and agrarian households is equal to  $L - L_F$ , where  $L$  is the total number of households (and also equal to adult labour supply). Thus, the demand for labour in effective units by low-quality producers of the *VDP* is equal to,

$$L_{IN}^D = \left( \frac{\theta^* - 1}{\gamma - 1} \right) L_F Q_{IN} + (L - L_F) Q_{IN} . \quad (18)$$

The demand for labour by the agrarian sector,  $L_A^D$ , is (implicitly) defined by equation (3). Under the assumptions of inter-sectoral labour mobility and perfect substitutability between adult and child workers, the wage (per effective unit of labour) in the informal sector is determined by the requirement that the number of effective labour units demanded in the informal and agrarian sectors are equal to the relevant labour supply. The latter is equal to the sum of the number of households not employed in the formal

sector ( $= L - L_F$ ), plus the supply of children in effective units ( $= b(1-s)(L - L_F)$ ).

Thus, labour-market clearing obtains if,

$$L_F^D + L_{IN}^D + L_A^D = (L - L_F) + b(1-s)(L - L_F). \quad (19)$$

Assuming that households always prefer to find employment in the formal sector so that  $L_F^D = L_F$ , equation (19) can be equivalently written as,

$$L_F^D + L_{IN}^D + L_A^D = L + b(1-s)(L - L_F). \quad (20)$$

Equation (20) just states that the economy-wide demand of effective labour units is equal to their supply; substituting equations (17) and (18) into this equation, we can write the condition for labour market equilibrium as,

$$\left( \frac{\gamma - \theta^*}{\gamma - 1} \right) L_F Q_F + T Q_F + \left( \frac{\theta^* - 1}{\gamma - 1} \right) L_F Q_{IN} + (L - L_F) Q_{IN} + L_A^D = L + b(1-s)(L - L_F). \quad (21)$$

Using similar reasoning, we can write the aggregate demand for the agrarian good as the sum of the corresponding demands of the four types of households in our model. These are the formal-sector households consuming the high-quality *VDP*, the formal-sector households consuming the low-quality *VDP*, the households earning the informal wage (informal plus agrarian households), and the landowning households. Using equation (2), we get the market-clearing equation for the homogeneous good:

$$\begin{aligned} & \left( \frac{\gamma - \theta^*}{\gamma - 1} \right) (W_M - W_M Q_F - F) L_F + \left( \frac{\theta^* - 1}{\gamma - 1} \right) (W_M - W_{IN} Q_{IN}) L_F + \\ & + (L - L_F) (W_{IN} + b(1-s)W_{IN} - W_{IN} Q_{IN}) + \left[ \frac{(1-\alpha)BL_A^\alpha}{T} - W_M Q_F - F \right] T = BL_A^\alpha. \end{aligned} \quad (22)$$

Equations (3), (15), (21), and (22) solve (implicitly) for the endogenous variables  $\theta^*, W_{IN}, L_F, L_A$ . These variables can in turn be used along with the rest of the equations to determine the allocation of labour across sectors, the size of child employment, and the welfare achieved by each member of the various household groups.

### 3. Policy Analysis

In this section we discuss the effects of changes in the institutional/policy environment on the incidence of child labour, the size of the (in)formal sector, and welfare. We assume throughout that the (exogenous) changes considered are small so as to ensure that the induced changes in the market-clearing wage paid to informal-sector workers

(modern plus agrarian) do not cause it to rise to the level of the minimum wage. We also evaluate changes in the welfare of different types of households without taking into account the non-pecuniary effects arising from changes in the supply of child labour. The proofs for our results are provided in the Appendix.

### ***3.1 Stricter Enforcement of Child Labour Regulation.***

We consider an increase in  $CLR$ , which, in our model is captured by an increase in parameter  $s$ . This causes an immediate decrease in child labor supply ( $= (1-s)(L - L_F)$ ), and as a result the market-clearing wage paid by informal employers in both the modern and agrarian sectors increases. The effect of this increase is a rise in the cost of producing ( $= W_{IN} Q_{IN}$ ) the low-quality variety of the  $VDP$  in the informal sector. The resulting rise in the price of the informally-produced variety induces some of the households initially working in the formal sector to switch their demand towards the high-quality variety (i.e.,  $\theta^*$  falls). The increased demand for the high-quality variety will induce a rise in formal-sector employment (and in the number of households earning the minimum wage), thus resulting in a decrease in employment in the informal sectors (modern and agrarian). This reallocation of economic activity away from the informal sectors will reduce the number of households sending their children to work, thus reinforcing the initial reduction in the supply of child labour.<sup>11</sup> We summarize the effects of stricter  $CLR$  ( $s \uparrow$ ) in the following proposition.

**Proposition 1:** *Stricter enforcement of CLR results in an expansion of formal economic activity, a rise in the market-clearing wage ( $W_{IN}$ ), a decline in the incidence of child labour, and in the size of the informal sectors. It also leads to: a welfare decrease for formal-sector households who continue to consume the low-quality variety, as well as for the landowning households; an increase in welfare of households shifting from informal to formal employment; no change in the welfare of formal-sector households who continue to consume the high-quality variety; an ambiguous effect on the welfare of households remaining in the informal sectors.*

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<sup>11</sup>This effect is similar to the one derived by Dinopoulos and Zhao (2007) when considering the case of a complete ban on child labour.

The effects on the welfare of various groups follow directly from the changes in  $W_{IN}$  and in the price of the low-quality variety. The rise in the price of the low-quality variety makes those minimum-wage earning households which either still prefer to consume the low-quality variety, or have been induced by the price rise to switch their demand to the high-quality variety worse-off. This is shown in Figure 2 for two such households. The initial situation, before the rise in  $s$ , has both households achieving higher utility by consuming the low-quality variety, i.e., they prefer point **1** over point **2**. The rise in the price of the low-quality variety makes the feasible budget point shift to point **3** if the household is to buy the low-quality variety, but preserves point **2** as a feasible consumption bundle. Faced with this shrinkage of “real income”, household **a** (the one with the steeper indifference map) chooses to switch his consumption towards the high-quality variety at point **2**; in contrast, household **b** finds it optimal to continue consuming the informal-sector variety and shifts to point **3**. In both cases the households suffer a drop in welfare.<sup>12</sup>

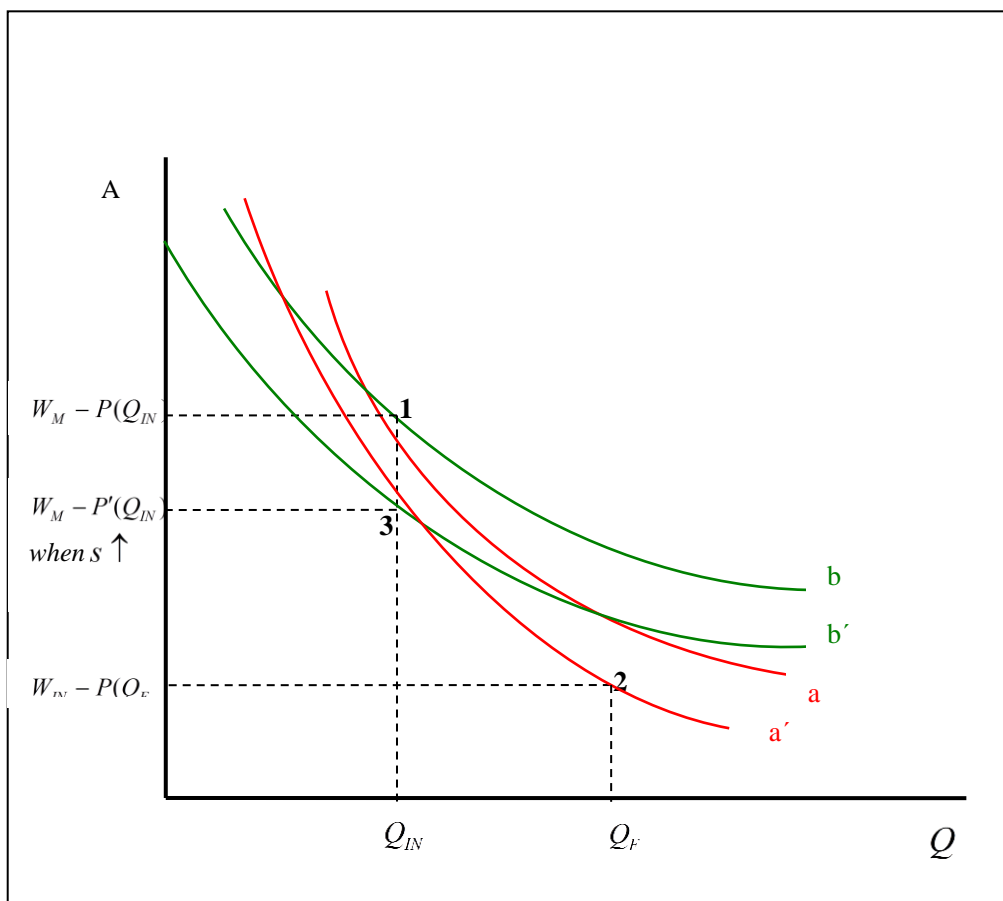


Figure 2: Response of minimum wage households to a rise in  $s$

<sup>12</sup>We note that the shift to consuming the more “luxurious” formal-sector variety is not associated with a rise in household utility.

The effects on welfare of the other groups of households can be visualized in a similar manner. We note that the ambiguous effect on the welfare of households remaining in the informal sectors after the rise in  $s$ , despite the increase in wages, is due to the fall in the effective labour units supplied by each household.

The ambiguous influence on the welfare of different households identified above provides a cautionary tale of policies which achieve their stated objectives, e.g. reduction in child labour and in the size of the informal sector, but may be welfare reducing for large parts of the population. It also explains also why a stricter enforcement of *CLR* does not receive widespread support in many developing countries,<sup>13</sup> and why some countries have supplemented their campaigns against child labour with various (cash or non-cash) transfer programs in order to garner political support among low-income households for these initiatives.<sup>14</sup>

### ***3.2 Increase in minimum wage***

The policy choice of minimum wage regulation as a policy lever with regard to child labour has been suggested as a more realistic and feasible policy instrument compared with the case of a full ban for developing economies given that “.....a direct ban on child labor is very difficult to implement. And though adult minimum wages are also hard to implement, most countries have such legislation already in place and some mechanism for implementing” (Basu, 2000).

In our set up the coverage of minimum wage legislation is limited to adult workers employed in the formal sector. Consider the effect of an increase in the (binding) minimum wage  $W_M$  on the proportion of formal-sector households which choose to buy the high-quality variety. The partial equilibrium effect (i.e. ignoring the effects on the market clearing wage) can be found from equation (15). This equation implies that,

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<sup>13</sup>This is consistent with Hatipoglu and Ozbek’s (2011) finding that the presence of an informal sector places severe limits on the political feasibility of large scale redistribution.

<sup>14</sup>Given the strained public finances of many developing countries, the U.N. World Food Program is a very important endeavour in this respect. This initiative runs a model foreign aid effort called the school feeding program, and it offers free meals to children in poor schools (and an extra bribe of grain for girl students to take home to their families).

$$\frac{\partial \theta^*}{\partial W_M} = \frac{(1-Q_F)Q_{IN}W_{IN} - F}{A_F^L [\ln(Q_F) - \ln(Q_{IN})]}. \quad (23)$$

We find that the effect is ambiguous; a *ceteris paribus*- increase in the minimum wage may either increase, or reduce, the proportion of formal-sector households consuming the high-quality variety. This ambiguity results from the influence of two forces: The first one can be termed the “substitution effect”, and it arises because the increase in the minimum wage raises the (relative) cost and price of the high-quality variety, thus inducing households to switch their demand towards the informally-produced variety. The second can be termed the “income effect”, and it arises because the increase in the minimum wage results in an increase in the real income of formal-sector households, thus inducing them to spend more on the *VDP* – i.e., to switch their demand towards the high-quality variety. The higher is parameter  $F$  (which measures the “cost of formality”), the more likely it becomes that the income effect will prevail. This is because the higher is  $F$ , the lower is the proportional rise in the (cost) price of the high-quality variety as a result of the rise in  $W_M$ , and thus the smaller the influence of the substitution effect and the larger the influence of the income effect.

Although we have no direct evidence about the size of  $F$ , we note that  $F$  can also be interpreted as the proportion of non-wage costs in total costs per physical unit of the *VDP* since  $AC(Q_F) = W_M Q_F + F$ . Under this interpretation, in developed economies  $F$  is usually larger than the (direct) wage costs, i.e.  $F > W_M Q_F$ . In what follows we shall assume a significantly weaker condition regarding the relative size of  $F$ ; we assume  $F \succ (1-Q_F)Q_{IN}W_{IN}$ . This assumption ensures that a rise in  $W_M$  results in a rise in the proportion of formal-sector households consuming the high-quality variety. Provided this assumption holds we can summarize the effects of a rise in the minimum wage with the following proposition.

**Proposition 2.** *A rise in the minimum wage results in a rise in formal economic activity, a rise in the market-clearing wage, and a decline in child employment. It can also lead to a rise in the welfare of all working households, whereas land-owning households suffer a welfare decline.*



The expansion of formal-sector employment as a result of the rise in  $W_M$  is due to the possibility that the income effect of the wage rise is stronger than the substitution effect, thus inducing a larger fraction of formal-sector households to consume the high-quality variety of the  $VDP$ . This income effect is absent in the analysis of Basu (2000), where a rise in the minimum wage can reduce adult employment, thus forcing the household to send the children to work. In our model, the increased demand for the variety produced in the formal sector, results in an increase in formal-sector employment and a rise in the number of households that can afford not to send their children to work.

The increase in formal sector employment impacts negatively on the available labour supply in the other two sectors ( $= (L - L_F)(1 + b(1 - s))$ ), thereby generating an increase in the market-clearing wage similar to the one caused by the increased  $CLR$  examined earlier.<sup>15</sup> Our framework thus provides a particular channel in support of the *lighthouse effect* of minimum wages on the informal wage and their positive impact on the reduction of child labour.<sup>16</sup> Empirical evidence in support of this prediction has been provided by Fajnzylber (2001) and Lemos (2004) for Brazil, and Jones (1997) for Ghana. Maloney and Nunez (2003), in particular, found that in Mexico, Argentina, Uruguay, Brazil, Chile, Honduras and Colombia "the influence of the minimum wage appears is more significant in the informal sector than in the formal sector".

An increase in minimum wage in our framework not only it succeeds in reducing child employment, but it may also be more likely to pass the test of political feasibility since with the exception of landowners all other households may gain from it.

### ***3.3 Increase in agrarian labor productivity***

In specific-factors models, the typical consequence from an (exogenous) increase in labour productivity of one sector is the expansion in the employment of this sector and

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<sup>15</sup>What prevents policymakers in our model from eliminating informality totally (in the modern sector) by continuing to increase the minimum wage? Apart from political economy considerations (e.g. landlords may have the political power to prevent such wage increases), our model suggests that as wages keep increasing, the condition  $F \succ (1 - Q_F)Q_{IN}W_{IN}$ , will no longer be satisfied, and thus further minimum wage increases will be counter-productive (in the sense of decreasing formal-sector employment and increasing child labour).

<sup>16</sup>The term *lighthouse effect* (EfeitoFarol) was introduced in the literature by Souza and Baltar (1980).

the contraction of employment in the other sector; e.g. due to a rise in agrarian labour productivity, there would be a decline in manufacturing employment. This is not the case in our framework. Instead, the rise in agrarian labour productivity leads to an increase in the market-clearing wage rate, and raises the price of the informally-produced, low-quality variety of the *VDP*. As a result, some minimum-wage households will switch their demand towards the high-quality variety, thus engendering a rise in formal-sector employment. The decline in informal employment will in turn lead to a fall in child employment. We thus reach the paradoxical result that improvements in the productive capacity of a sector employing child labour can cause a decline in the economy-wide incidence of child labour.

The rise in agrarian labour productivity does not benefit all households. Minimum-wage earning households who were previously consuming the low-quality variety will suffer a reduction in welfare (even if they switch their demand towards the high-quality variety after the rise in the cost of the low-quality variety). Landowners may also suffer a decline in their welfare, since in addition to the rise in the (real) wage paid to the workers, agricultural employment (in effective units) will also fall. The latter change is a consequence of the fact that not only the production of more high-quality units requires more workers than those released from the production of low-quality varieties, but also due to the decline of child labour caused by the reduction of adult employment in the informal sectors.

Does this conclusion imply that landowners would block any government efforts to boost the productivity of the agrarian sector through spending on agricultural research or infrastructure projects? We regard it as unlikely that landowners will “see through” the possible general equilibrium effects of government efforts to boost the productivity of the agrarian sector will have on their incomes. Moreover, given the beneficial effects on other groups of households, such a government initiative may be politically feasible. In addition, the government could, in principle, use its efforts to support other types of activities which directly benefit the formal sector, e.g. by embarking on policies which decrease the cost of formality (a decrease in  $F$ ). Since it is evident that such policies

constitute a direct method to eliminate some of the sources of informality and reduce child labour, we abstain from further discussion of this issue.<sup>17</sup>

### ***3.4 Decrease in population (labour supply)***

The effects of decreases in labour supply in our framework can be captured through a decrease in the number of working households,  $L$ , thus producing an equi-proportionate decrease in the supply of effective labour units. (We may also think that this comes about through emigration, provided that the new households consist also of one adult and of one child; this is similar to the migration pattern considered by Dinopoulos and Zhao (2006).) Given the assumption of diminishing returns in the agrarian sector, the diminished supply of labour will result in an increase in the market-clearing wage, which in turn will increase the price of the informally-produced, low-quality variety. This will induce some of the minimum-wage earning households to switch their demand towards the high-quality variety, thus increasing employment in the formal sector, and decreasing the employment of both adults and children in the informal sectors. As a result, the fall in adult and child employment in the informal sectors will be larger than the decrease in labour supply, thus decreasing the share of the informal sectors in the economy. The consequence of these changes is an increase in the *absolute* size of formal- sector employment as aggregate employment contracts. This outcome is in contrast with Dinopoulos and Zhao (2006) who find that "... emigration of unskilled labour can indeed exasperate the problem of child labour by increasing the demand for working children".

Our framework suggests that for countries which receive migrant workers, and in which child labour and the informal sector are integral parts of the economy, immigration will increase both informality and the incidence of child labour. The experience of Turkey<sup>18</sup> during the last two decades provides an example which is not at variance with

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<sup>17</sup>We note also that since the cost of formality partly consists of taxes that generate revenue who finance vital government spending, it may not be sensible to rely on tax cuts to reduce  $F$ . It is clear that a proper treatment of this issue requires that full consideration to the tax structure and the government budget constraint is given. Moreover, one should also consider whether issues of bureaucratic inefficiency are simply a matter of lack of the appropriate organizational capabilities, and not a conscious effort of rent-seeking groups to thwart the state's build-up of administrative capabilities.

<sup>18</sup>Traditionally (i.e., since the 1950s) Turkey has been known as a country of emigration. However, recently, Turkey has also become known as a country of transit to the European Union for irregular migrants from Asian countries such as Afghanistan, Bangladesh, Iraq, Iran, and Pakistan. Turkey has

this prediction; informality in the urban sectors – the main recipients of illegal immigrants - increased from about 29 percent in 2001 to about 34 percent in 2006 (World Bank, 2010).<sup>19</sup>

The welfare effects of changes in labour supply on landowners and formal-sector households which consume the low-quality variety of the *VDP* are straightforward: increases in labour supply decrease the market-clearing wage and affect positively the welfare of these groups. By analogy, all households which are working in the informal sector will be worse off. Finally, the welfare of households which continue to consume the high-quality variety remains unchanged. These effects suggest that the policies of countries which are net recipients of migrants will be sensitive to small changes in the political power of the affected groups.

#### **4. Conclusions**

The model of this paper has highlighted some links between the structure of product demand, relative wages, and the allocation of economic activity across the formal and informal sectors. These inter-connections have brought to light possible consequences of some widely discussed policy interventions, such as stricter enforcement of regulations on child labour and minimum wage increases. For example, minimum wage increases for formal-sector workers result in a reduction in child employment and a rise in the (market-clearing) informal wage rate. The paper has also shown that the beneficial effects of stricter child-labour regulation and minimum wage increases as far as child labour and informality are concerned, may not be enough to guarantee the required political support for their implementation.

The paper has used some stark assumptions in order to increase the transparency of the results. For example, the assumption that there is only one quality level produced by informal firms and one produced by formal firms could be easily relaxed without affecting the substance of our findings; it would still be true that some households

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also become a destination for irregular migrants from former Soviet Bloc countries, and the sum of legal and illegal immigration flow to the country is estimated to be larger than the total number of emigrants.

<sup>19</sup>We have no direct evidence about the change in child employment during the same period, although indirect evidence (from various countries) suggests (Perry et al., 2007) that the size of the informal economy and child employment are positively correlated.

would find it in their interest to switch their consumption from formal-sector to informal-sector varieties of the vertically differentiated product (or vice versa). The same also holds true for the production function of the agrarian good – any production function which displays diminishing returns would maintain the qualitative nature of our results. The model could also be interpreted as a small, open-economy one, with the agrarian good being internationally traded, and the vertically-differentiated product being non-traded. However, allowing for (international) trade in the differentiated product would probably alter some of our findings since, e.g. minimum wage increases would squeeze the market share of domestic, formal-sector, firms as they face both the low-quality domestic rivals (informal-sector firms) and foreign (possibly, higher-quality) rivals. An equally important extension would involve the introduction of the government budget constraint. This would allow for a proper analysis of how changes in the structure of taxation could be used to influence the influence the cost of formality and the allocation of economic activity across sectors.

## Appendix

The total differential of equations (5), (15), (20), and (21) can be written in matrix form as follows. The endogenous variables are  $\theta^*$ ,  $W_{IN}$ ,  $L_F$ ,  $L_A$ , while  $s$ ,  $W_M$ ,  $B$ , and  $L$  are the exogenous variables. :

$$(A.1) \quad \begin{pmatrix} 0 & 1 & 0 & (1-a)W_{IN}L_x^{-1} \\ 1 & \frac{Q_{IN}}{A_1} & 0 & 0 \\ \frac{L_F(Q_F - Q_{IN})}{\gamma - 1} & 0 & -G_1(Q_F - Q_{IN}) - b(1-s) & -1 \\ \frac{L_F(A_F^L - A_F^H)}{\gamma - 1} & L_A & A_2 & -\alpha W_{IN} \end{pmatrix} \begin{pmatrix} d\theta^* \\ dW_{IN} \\ dL_F \\ dL_{IN} \end{pmatrix} = \begin{pmatrix} 0 & 0 & \frac{W_{IN}}{B} & 0 \\ 0 & -\frac{F - (1 - Q_F)W_{IN}Q_{IN}}{A_1 A_F^H} & 0 & 0 \\ b(L - L_F) & 0 & 0 & -(1 - Q_{IN} + b(1-s)) \\ b(L - L_F)W_{IN} & 0 & \alpha L_A^a & -A_{IN} \end{pmatrix} \begin{pmatrix} ds \\ dW_M \\ dB \\ dL \end{pmatrix}$$

It will prove convenient for what follows to have in mind the following definitions:

$$(A.2) \quad G_1 = \frac{\gamma - \theta^*}{\gamma - 1} < 1 \quad \text{and} \quad (A.3) \quad A_F^H = W_M - W_M Q_F - F$$

$$G_2 = \frac{\theta^* - 1}{\gamma - 1} < 1 \quad A_F^L = W_M - W_{IN} Q_{IN}$$

$$A_{IN} = W_{IN} + W_{IN} b(1-s) - W_{IN} Q_{IN}$$

$$A_F^H, A_F^L, A_{IN} > 0$$

Let  $|D|$  denote the determinant of the endogenous variables. Its value is:

$$|D| = -A_2 \left[ \frac{A_1(\gamma - 1)L_A - (1 - \alpha)L_F W_{IN} Q_{IN}(Q_F - Q_{IN})}{A_1 L_A(\gamma - 1)} \right] - B_1 W_{IN} \left[ \frac{A_1(\gamma - 1)L_A - (1 - \alpha)L_F Q_{IN}(A_F^L - A_F^H)}{A_1 L_A(\gamma - 1)} \right]$$

where,

$$A_1 = A_F^L [\text{Log}(Q_F) - \text{Log}(Q_{IN})] = (W_M - W_{IN} Q_{IN}) [\text{Log}(Q_F) - \text{Log}(Q_{IN})] > 0 \quad (A.4)$$

$$A_2 = G_1 A_F^H + G_2 A_F^L - A_{IN} = W_M - (W_{IN} + W_{IN} b(1-s)) - G_1 (W_M Q_F + F - W_{IN} Q_{IN}) > 0 \quad (\text{A.5})$$

$$B_1 = G_1 (Q_F - Q_{IN}) + b(1-s) > 0$$

Given the above definitions, we can sign  $|D|$  once we take into account under what conditions the system is stable; i.e. the restrictions required so that increases in the market-clearing (informal) wage rate eliminate any excess demand for labour. Using equations (5), (15), (20), and (21) we find that the restrictions imposed by the *correspondence principle* are:

$$A_1 (\gamma - 1) L_A - (1 - \alpha) L_F Q_F (A_F^L - A_F^H) > 0 \quad \text{and}$$

$$(1 - \alpha) L_F Q_{IN} (A_F^L - A_F^H) - (1 - \alpha) L_F W_{IN} Q_{IN} (Q_F - Q_{IN}) = (1 - \alpha) L_F Q_{IN} (Q_F (W_M - W_{IN}) + F) > 0$$

Using these restrictions we find that  $|D| < 0$ .

### **Comparative Statics**

#### **A.1 Stricter Enforcement of CLR ( $s$ )**

Using Cramer's rule we get:

➤ *Decrease in  $\theta^*$*  (i.e. increase in the proportion of minimum-wage households

who buy the high-quality variety):  $\frac{d\theta^*}{ds} = \frac{|S_\theta|}{|D|} < 0$ ,

$$|S_{\theta^*}| = \frac{(1-a) Q_{IN} b (L - L_F) W_{IN} [A_2 + (b(1-s) + G_1 (Q_F - Q_{IN}) W_{IN})]}{A_1 L_A} > 0 \quad (\text{A.8})$$

where from (A.4) and (A.5)  $A_1 > 0$  and  $A_2 > 0$  respectively.

➤ *Increase in formal-sector employment  $L_F$* :  $\frac{dL_F}{ds} = \frac{|S_{L_F}|}{|D|} > 0$ ,

$$|S_{L_F}| = -\frac{(1-a) b Q_{IN} (L - L_F) W_{IN} (W_M Q_F + F - W_{IN} Q_F)}{A_1 L_A (\gamma - 1)} < 0 \quad (\text{A.9})$$

➤ *Increase in market-clearing wage  $W_{IN}$* :  $\frac{dW_{IN}}{ds} = \frac{|S_{W_{IN}}|}{|D|} > 0$ ,

$$|S_{W_{IN}}| = -\frac{(1-a) b (L - L_F) W_{IN} [A_2 + (b(1-s) + G_1 (Q_F - Q_{IN}) W_{IN})]}{L_A} < 0 \quad (\text{A.10})$$

➤ *Decrease in agricultural sector employment  $L_A$* :  $\frac{dL_A}{ds} = \frac{|S_{L_A}|}{|D|} < 0$ ,

$$|S_{L_A}| = b(L - L_F) \left[ A_2 + (b(1-s) + G_1(Q_F - Q_{IN})W_{IN}) \right] > 0 \quad (\text{A.11})$$

Finally, by totally differentiating equation (17) we get,

➤ *Decrease informal sector employment  $L_{IN}$ :*

$$\frac{dL_{IN}}{ds} = -(1+b(1-s)) \frac{dL_F}{ds} - b(L-L_F) \xrightarrow{(A.9)} \frac{dL_{IN}}{ds} < 0 \quad (\text{A.12})$$

### **Welfare effects**

➤ *Decrease in landowner's welfare  $U_T$*

Totally differentiating the utility function of the landowner,

$$U_T = \ln Q_F + \ln \left( \frac{(1-\alpha)BL_A^\alpha}{T} - W_M Q_F - F \right), \text{ we get:}$$

$$\frac{dU_T}{ds} = \frac{dU_T}{dL_A} \cdot \frac{dL_A}{ds} = \frac{(1-\alpha)W_{IN}}{TA_T} \cdot \frac{dL_A}{ds} < 0 \quad (\text{A.13}), \text{ since from (A.11), } \frac{dL_A}{ds} < 0 \text{ and from}$$

$$(16) A_T = \frac{(1-\alpha)BL_A^\alpha}{T} - (W_M Q_F + F) > 0$$

➤ *Decrease in formal household's welfare which consumes the low quality good:*

Differentiating the utility function of the formal household who consumes the low-

quality variety,  $U_F^L = \ln Q_F + \ln(W_F - W_{IN} Q_{IN})$ , we get

$$\frac{dU_F^L}{ds} = \frac{dU_F^L}{dW_{IN}} \frac{dW_{IN}}{ds} = -\frac{Q_{IN}}{A_F^L} \frac{dW_{IN}}{ds} = -\frac{Q_{IN}}{W_M - W_{IN} Q_{IN}} \frac{dW_{IN}}{ds} < 0 \quad (\text{A.14}), \text{ since from (A.10),}$$

$$\frac{dW_{IN}}{ds} > 0$$

➤ *No change in formal household's welfare which consumes the high quality good:*

$$\text{From differentiation of } U_F^H = \ln Q_F + \ln(W_F - W_F Q_F - F), \text{ we get } \frac{dU_F^H}{ds} = 0 \quad (\text{A.15})$$

➤ *Ambiguous effect on household's welfare which consumes the low quality good:*

In this case,  $U_{IN} = \ln Q_{IN} + \ln(W_{IN} + b(1-s)W_{IN} - W_{IN} Q_{IN})$ . Differentiating we get

$$dU_{IN} = \frac{\mathcal{G}U_{IN}}{\mathcal{G}s} ds + \frac{\mathcal{G}U_{IN}}{\mathcal{G}W_{IN}} dW_{IN} \Rightarrow \frac{dU_{IN}}{ds} = -\frac{bW_{IN}}{A_{IN}} + \frac{1}{W_{IN}} \frac{dW_{IN}}{ds} = -\frac{bW_{IN}}{W_{IN} + b(1-s)W_{IN} - W_{IN} Q_{IN}} + \frac{1}{W_{IN}} \frac{dW_{IN}}{ds} \quad (\text{A.16})$$



## A.2 Increase in minimum wage

Using Cramer's rule we get:

$$\begin{aligned} \text{➤ Decrease in } \theta^*: \quad \frac{d\theta^*}{dW_M} &= \frac{|W_{M\theta^*}|}{|D|} < 0, \\ |W_{M\theta^*}| &= \frac{[F - (1 - Q_F)P_{IN}][A_2 + (b(1-s) + G_1(Q_F - Q_{IN})W_{IN})]}{A_1 A_F^H} > 0 \end{aligned} \quad (\text{A.17})$$

where from (A.3) and (A.4)  $A_F^H = W_M - W_M Q_F - F > 0$  and  $A_1 > 0$  respectively

$$\begin{aligned} \text{➤ Increase in formal-sector employment } L_F: \quad \frac{dL_F}{dW_M} &= \frac{|W_{MLF}|}{|D|} > 0 \\ \text{where } |W_{MLF}| &= -\frac{L_F [F + Q_F (W_M - W_{IN})][F - (1 - Q_F)P_{IN}]}{A_1 A_F^H (\gamma - 1)} < 0 \end{aligned} \quad (\text{A.18})$$

$$\begin{aligned} \text{➤ Decrease in agricultural sector employment } L_A: \quad \frac{dL_A}{dW_M} &= \frac{|W_{MLA}|}{|D|} < 0 \text{ where} \\ |W_{MLA}| &= \frac{L_F [F - (1 - Q_F)Q_{IN}W_{IN}][A_2(Q_F - Q_{IN}) + B_1(A_F^L - A_F^H)]}{A_1 L_A (\gamma - 1) A_F^H} > 0 \end{aligned} \quad (\text{A.19})$$

$$\begin{aligned} \text{➤ Increase in market clearing wage } W_{IN}: \quad \frac{dW_{IN}}{dW_M} &= \frac{|W_{INWM}|}{|D|} > 0 \text{ where} \\ |W_{INWM}| &= \frac{(1-a)L_F W_{IN} [F - (1 - Q_F)Q_{IN}W_{IN}][A_2(Q_F - Q_{IN}) + B_1(A_F^L - A_F^H)]}{A_1 L_A (\gamma - 1) A_F^H} < 0 \end{aligned} \quad (\text{A.20})$$

## Welfare effects

➤ Decrease in landowner's welfare  $U_T$

$$\begin{aligned} dU_T &= \frac{\mathcal{G}U_T}{\mathcal{G}L_A} dL_A + \frac{\mathcal{G}U_T}{\mathcal{G}W_M} dW_M = \frac{(1-a)W_{IN}}{TA_T} dL_A - \frac{Q_F}{A_T} dW_M \Rightarrow \frac{dU_T}{dW_M} = \frac{(1-a)W_{IN}}{TA_T} \cdot \frac{dL_A}{dW_M} - \frac{Q_F}{A_T} < 0 \\ (\text{A.21}), \text{ since } \frac{dL_A}{dW_M} &> 0 \end{aligned}$$

➤ Ambiguous effect on formal household's welfare if it consumes the low quality good

$$\frac{dU_F^L}{dW_M} = \frac{\mathcal{G}U_F^L}{\mathcal{G}W_{IN}} \frac{dW_{IN}}{dW_M} + \frac{\mathcal{G}U_F^L}{\mathcal{G}W_F} = -\frac{Q_F}{A_F^L} \frac{dW_{IN}}{dW_M} + \frac{1}{A_F^L} (\text{A.22}), \text{ since from (A.20) } \frac{dW_{IN}}{dW_M} > 0.$$

➤ Increase in formal household's welfare in case it consumes the high quality good

$$\frac{dU_F^H}{dW_M} = \frac{\mathcal{G}U_F^H}{\mathcal{G}W_M} = \frac{1-Q_F}{A_F^H} > 0 \quad (\text{A.23})$$

➤ Increase in informal household's welfare which consumes the low quality good

$$\frac{dU_{IN}}{dW_M} = \frac{dU_{IN}}{dW_{IN}} \frac{dW_{IN}}{dW_M} = \frac{1}{W_{IN}} \frac{dW_{IN}}{dW_M} > 0 \quad (\text{A.24}) \text{ since from (A.20) } \frac{dW_{IN}}{dW_M} > 0$$

### A3. Increase in agricultural labor productivity (B)

Using Cramer's rule we get:

➤ Decrease in  $\theta^*$ :  $\frac{d\theta^*}{dB} = \frac{|B_{\theta^*}|}{|D|} < 0$ ,

where  $|B_{\theta^*}| = \frac{Q_{IN} W_{IN} [A_2 + (b(1-s) + G_1(Q_F - Q_{IN})W_{IN})]}{A_1 B} > 0 \quad (\text{A.25})$

➤ Increase in employment in formal sector  $L_F$ :  $\frac{dL_F}{dB} = \frac{|B_{L_F}|}{|D|} > 0$

where  $|B_{L_F}| = -\frac{L_F Q_{IN} W_{IN} [F + Q_F (W_M - W_{IN})]}{A_1 B (\gamma - 1)} < 0 \quad (\text{A.26})$

➤ Decrease in agricultural sector employment  $L_A$ :  $\frac{dL_A}{dB} = \frac{|B_{L_A}|}{|D|} < 0$

where  $|B_{L_A}| = \frac{L_F Q_{IN} W_{IN} [F + Q_F (W_M - W_{IN}) + (Q_F - Q_{IN})] (W_M - W_{IN})}{A_1 B (\gamma - 1)} > 0 \quad (\text{A.27})$

➤ Increase in market clearing wage  $W_{IN}$ :  $\frac{dW_{IN}}{dB} = \frac{|B_{W_{IN}}|}{|D|} > 0$

Where  $|B_{W_{IN}}| = -\frac{W_{IN} [A_2 + (b(1-s) + G_1(Q_F - Q_{IN})W_{IN})]}{B} < 0 \quad (\text{A.28})$

### Welfare issues

➤ Ambiguous effect on landowner's welfare

$$dU_T = \frac{\mathcal{G}U_T}{\mathcal{G}B} dB + \frac{\mathcal{G}U_T}{\mathcal{G}L_A} dL_A \Rightarrow \frac{dU_T}{dB} = \frac{(1-a)L_A^{\alpha-1} \left[ aB \frac{dL_A}{dB} + L_A \right]}{T \left( \frac{(1-\alpha)BL_A^\alpha}{T} - W_M Q_F - F \right)} \quad (\text{A.29})$$

➤ Decrease in formal household's welfare in case it consumes the low quality good

$$\frac{dU_F^L}{dB} = \frac{dU_F^L}{dW_{IN}} \frac{dW_{IN}}{dB} = -\frac{Q_F}{W_M - W_{IN}Q_{IN}} \frac{dW_{IN}}{dB} < 0 \text{ (A.30), since } \frac{dW_{IN}}{dB} = \frac{|W_{IN_B}|}{|D|} > 0$$

➤ No change in formal household's welfare in case it consumes the high quality good

$$U_F^H = \ln Q_F + \ln(W_F - W_F Q_F - F), \text{ implying } \frac{dU_F^H}{dB} = 0 \quad (\text{A.31})$$

➤ Increase in informal household's welfare which consumes the low quality good  $U_{IN}$

$$\frac{dU_{IN}}{dB} = \frac{dU_{IN}}{dW_{IN}} \frac{dW_{IN}}{dB} = \frac{1}{W_{IN}} \frac{dW_{IN}}{dB} > 0 \quad (\text{A.32})$$

#### A4. Increase in labor supply (L)

Using Cramer's rule we get:

$$\text{➤ Increase in } \theta^*: \frac{d\theta^*}{dL} = \frac{|L_{\theta^*}|}{|D|} < 0,$$

$$\text{where } |L_{\theta^*}| = -\frac{Q_{IN}(1-\alpha)A_{IN} [A_2 + (b(1-s) + G_1(Q_F - Q_{IN})W_{IN})]}{A_1 L_A} < 0 \quad (\text{A.33})$$

$$\text{➤ Decrease in formal sector employment } L_F: \frac{dL_F}{dL} = \frac{|L_{L_F}|}{|D|} < 0$$

$$\text{where } |L_{L_F}| = \frac{(1-\alpha)L_F Q_{IN} A_{IN} [Q_F(W_M - W_{IN}) + F]}{A_1 L_A (\gamma - 1)} > 0 \quad (\text{A.34})$$

$$\text{➤ Increase in agricultural sector employment } L_A: \frac{dL_A}{dL} = \frac{|L_{L_A}|}{|D|} > 0$$

$$\text{where } |L_{L_A}| = -\frac{A_{IN} [W_M - W_{IN} - G_1(W_M Q_F + F - W_{IN} Q_{IN})]}{W_{IN}} < 0 \quad (\text{A.35})$$

$$\text{➤ Decrease in market clearing } W_{IN}: \frac{dW_{IN}}{dL} = \frac{|L_{W_{IN}}|}{|D|} < 0$$

$$\text{where } |L_{W_{IN}}| = \frac{(1-\alpha)A_{IN} [A_2 + (b(1-s) + G_1(Q_F - Q_{IN})W_{IN})]}{L_A} > 0 \quad (\text{A.36})$$

#### Welfare issues

➤ Increase in landowner's welfare  $U_T$

$$\frac{dU_T}{dL} = \frac{dU_T}{dL_A} \frac{dL_A}{dL} = \frac{(1-a)W_{IN}}{T \left( \frac{(1-\alpha)BL_A^a}{T} - W_M Q_F - F \right)} \frac{dL_A}{dL} > 0 \text{ (A.37) since } \frac{dL_A}{dL} > 0$$

➤ Increase informal household's welfare in case it consumes the low quality good

$$\frac{dU_F^L}{dL} = \frac{dU_F^L}{dW_{IN}} \frac{dW_{IN}}{dL} = -\frac{Q_F}{W_M - W_{IN}Q_{IN}} \frac{dW_{IN}}{dL} > 0 \text{ (A.38) since } \frac{dW_{IN}}{dL} = \frac{|L_{W_{IN}}|}{|D|} < 0$$

➤ *No change in formal household's welfare in case it consumes the high quality good*

$$U_F^H = \ln Q_F + \ln(W_F - W_F Q_F - F), \quad \frac{dU_F^H}{dL} = 0 \quad \text{(A.38)}$$

➤ *Decrease in informal household's welfare which consumes the low quality good*

$$U_{IN}$$

$$\frac{dU_{IN}}{dL} = \frac{dU_{IN}}{dW_{IN}} \frac{dW_{IN}}{dL} = \frac{1}{W_{IN}} \frac{dW_{IN}}{dL} < 0 \text{ (A.39), since } \frac{dW_{IN}}{dL} = \frac{|L_{W_{IN}}|}{|D|} < 0.$$

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