On structural change, the social stress of a farming population, and the political economy of farm support

By ODED STARK and JAN FAŁKOWSKI

On structural change, the social stress of a farming population, and the political economy of farm support[1]

Oded Stark* and Jan Fałkowski**

*Universities of Bonn and Warsaw
**University of Warsaw

Abstract

A rationale for providing support to the farm sector in the course of economic development and structural change is a growing gap between the incomes of non-agricultural workers and the incomes of farmers. Drawing on a model that enables us to analyze the level of social stress experienced by farmers as employment shifts from the farm sector to other sectors, we find that even without an increasing gap between the incomes of non-agricultural workers and the incomes of farmers, support to farmers might be needed/can be justified. This result arises because under well-specified conditions, when the size of the farm population decreases, those who remain in farming experience increasing aggregate social stress. The increase is nonlinear: it is modest when the outflow from the farm sector is relatively small or when it is large, and it becomes more significant when the outflow is moderate. This finding can inform policymakers who seek to alleviate the social stress of the farming population as to the timing and intensity of that intervention.

[1] We are indebted to a referee for thoughtful comments, and to Guido Friebel for advice and guidance.

1. Introduction

Extensive literature shows that in a great many episodes of development and transition, economic growth is accompanied by the transfer of production resources from the farm sector to the industrial and services sectors (Kuznets, 1966; Caselli and Coleman, 2001; Matsuyama, 2008). Starting from a seminal paper by Lewis (1954) it has long been recognized that agriculture importantly contributes to economic development not only by providing food and raw materials to the non-agricultural sectors but also, and more importantly, by serving as a source of unlimited supply of labor. Thanks to this, wages in the industrial sector remain constant and capital accumulation can be sustained. The early development literature indicated also that sustaining the process of investment in the industrial sector (especially in the closed economy), might require the savings in the agricultural sector to be taxed (Lewis, 1954; Johnston and Mellor, 1961).

In line with these arguments, the governments of many developing countries have taxed their farmers, drawing on the proceeds to expand the industrial sector (Anderson *et al.*, 2013). However, in more advanced countries this tendency seems to be reversed (Lindert, 1991): as these countries developed economically and agriculture shrank in relation to the rest of the economy, farmers have often received substantial support from public coffers. This phenomenon has been referred to as a "developmental paradox" (Barrett, 1999; Paarlberg, 2013). The experience of developing countries in the past half century constitutes a good example. Anderson *et al*. (2010) show that in the 1960s and 1970s, governmental policies in developing countries in effect taxed the gross earnings of farmers, reducing them by about 20 percent on average. Since the 1980s, however, the anti-agricultural bias of the policies has been gradually eroded. As a result, during 2000–2004, the revised policies served to increase the gross earnings of farmers by nine percent above what those earnings would have been in the absence of government intervention. The observed change from taxing agricultural producers to protecting them was particularly pronounced in the fastest growing countries in Asia, and was somewhat less stark in the slowest growing countries in Africa.

Among the factors described as accounting for greater public support for farmers in more developed economies, special attention has been paid to structural changes that are inherent to the process of economic growth. A broad consensus has emerged that subsidies to farmers and other means of supporting them are an appropriate response to an increasing gap between the incomes of workers in the non-agricultural sectors of the economy and the incomes of farmers (de Gorter and Swinnen, 2002; Swinnen, 2010; Anderson *et al*., 2013). The increasing gap has been observed in many historical and geographical contexts (Eastwood and Lipton, 2000; Cornia and Kiiski, 2001 and the studies cited therein). The experience of East Asian countries, including Japan, Korea, and Taiwan, after the Pacific War, constitutes a prominent example (Anderson *et al*., 1986).

In this paper, we shed new light on the justification for public support for farmers when economies experience an outflow of production resources from the agricultural sector to the non-agricultural sectors. Our aim is not to challenge the common explanation that an increasing gap between non-agricultural and agricultural incomes is a reason for farmers being given support. Instead, we offer a complementary view. We argue that a fall in agricultural incomes relative to incomes in the rest of the economy is not necessary for farmers to experience a relative fall in prosperity, and for politicians to supply the farm sector with support. Using a model that enables us to quantify farmers' aggregate social stress (we define this term below), we are able to infer that farmers have a "justifiable" case to lobby (ask) for bigger subsidies, lower taxes, and similar measures even when in the course of structural change the income gap between workers in industry and services and farmers remains unchanged. The mechanism that drives this impact is increased aggregate social stress that farmers experience when their fellow farmers leave the farming sector for work in industry and services.

Assessment of the relationship between farm support and the size of the farming population is not unique to this paper. Based on the "interest group theory" pioneered by Olson (1965), follow-up studies argued that as the economy develops and the number of farmers drops, the cost of political collective action for the remaining farmers declines. This change increases the effectiveness of lobbying, and results in higher levels of farm support (Swinnen, 1994; de Gorter and Swinnen, 2002; Anderson *et al*., 2013 and the studies cited therein). Our argument is different. We maintain that the case for providing farm support and the incentive for farmers to lobby for financial transfers to the farm sector can arise not merely because a smaller group size renders collective action easier. The "case" arises also because the outflow from the farm sector affects the level of aggregate social stress of those who remain in the sector. In pursuing this line of reasoning, we come close to but also differ from researchers who explained why farmers are able to overcome collective action problems (Nedergaard, 2006), or who identified the particular factors that play a part in the shaping of government policies that affect farmers (Salhofer *et al*., 2000).

In order to assess how the outflow of production resources from the agricultural sector influences the farmers' "case" for asking for subsidies, protection, and other forms of support, we quantify the change in the aggregate social stress of farmers as transformation takes its course. We show that in the course of the economy's transformation, the change in social stress experienced by farmers who remain in the farm sector can be broken down into two components: one that is related to a change in the income gap between the industrial and services sectors on the one hand and the farm sector on the other, and another that is related to a change in the occupational structure of the economy, namely to a shift of employment away from farming to other sectors of the economy. We then show that the relationship between the number of farmers who leave the agricultural sector and the component of the aggregate social stress arising from the occupational structure of

the economy has an inverted U shape: the aggregate social stress related to the occupational structure first increases and later decreases with the outflow from the agricultural sector. Importantly, this result holds irrespective of whether the relative income situation of the farmers deteriorates or not. Our model also indicates that if the number of farmers who become workers in industry and services is large enough, then the aggregate social stress of the remaining farmers will decrease even when the income gap between non-agricultural workers and farmers does not change. In addition, we are able to define the minimal level of support to farmers that, in the wake of the structural change of the economy, will keep their aggregate level of social stress unchanged. Should policymakers seek to alleviate the social stress of the farming population caused by the economy's transformation, our finding could inform them as to when to interfere, and at what level of intensity of the farmers' social stress.

The necessary condition for deriving our results that the aggregate social stress related to the occupational structure first increases and later decreases as the outflow from the agricultural sector progresses, is that initially the majority of the population works in farming. And we consider the case in which the number of farmers who switch from farming to non-agricultural work is not especially large. It might be reassuring to note that these conditions are fulfilled by the experience of a great many countries that have undergone structural change. The changes in the share of agricultural employment in total employment in the early stages of transformation in currently advanced economies (Caselli and Coleman, 2001; Jorgenson and Timmer, 2011; Herrendorf *et al.*, 2014) and in many developing countries (Timmer *et al.*, 2014) are good examples. In the U.S., the share of the labor force in agriculture in 1880 was 50%. It fell to 39% in 1900, to 26% in 1920, and to 20% in 1940, implying an annual rate of decrease of 0.5% over this 60-year period (Caselli and Coleman, 2001). A similar pattern characterizes Western Europe (Herrendorf *et al.*, 2014). Figure 1 shows how the share of agricultural employment in total employment likewise changed over time in Africa, Asia, and Latin America.

Our analysis contributes to two strands of the literature. First, it relates to extensive writings that seek to explain the channeling of public support to the farming sector. (Overviews of existing studies are provided by de Gorter and Swinnen, 2002, and by Anderson *et al.*, 2013.) Although this literature has typically placed a strong emphasis on the fact that policies in support of the agricultural sector are importantly driven by structural adjustments taking place during the process of economic development, the specific mechanism that we present in this paper has not been studied before. Second, our analysis relates to writings on structural change (for a succinct literature review, see Matsuyama, 2008), and to studies that focus specifically on the transformation of the agricultural sector (Spoor, 2009; Swinnen, 2009). This literature refers to a variety of socio-economic changes taking place during structural changes, and seeks to explain the different forces that have influenced the decisions of farmers to remain in agriculture, or to move to other sectors. That being said, to the best of our knowledge our paper is the first to

Figure 1. Share of agricultural employment in total employment: Africa, Asia, and Latin America, 1960–2010.
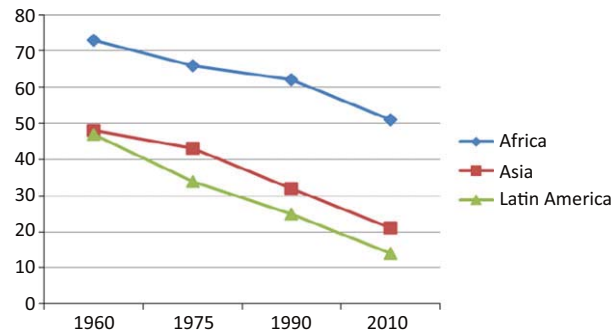
Source: Timmer *et al*. (2014). [Colour figure can be viewed at wileyonlinelibrary.com]

analyze changes in the occupational structure of the economy in conjunction with changes in the aggregate social stress of the farming population. We are also not aware of other papers that have broken down the latter aggregate into a component related to changes in the inter-sectoral income gap, and a component related to occupational migration from the farm sector to work in the non-farming sector.

In Section 2 we introduce the measure that we will subsequently use to analyze the level of social stress experienced by farmers as employment shifts from the farm sector to other sectors. In Section 3 we present methodological considerations related to differentiating between relative deprivation, poverty, and inequality; to stress-related considerations; and to evidence linking stress with relative deprivation. In Section 4 we employ the measure introduced in Section 2 and find that even without an increasing gap between the incomes of non-agricultural workers and the incomes of farmers, support to farmers might be needed/can be justified. Section 5 draws on the analysis performed in Section 4 to inform policymakers who seek to alleviate the social stress of the farming population as to the timing and intensity of that intervention. Section 6 concludes.

2. Background information on the concept of relative deprivation and on a measure of social stress

2.1 A brief history of relative deprivation in economics

Considerable economic analysis has been inspired by the sociological-psychological concepts of relative deprivation (*RD*) and reference groups. Economists have come

to consider these concepts as fitting tools for studying comparisons that affect an individual's behavior, in particular, comparisons with related individuals whose incomes are higher than his own income (cf. the large literature spanning from Duesenberry, 1949, to, for example, Clark *et al.*, 2008). An individual has an unpleasant sense of being relatively deprived when he lacks a desired good and perceives that others in his reference group possess that good (Runciman, 1966).[2] Given the income distribution of the individual's reference group, the individual's *RD* is the sum of the deprivation caused by every income unit that he lacks (Yitzhaki, 1979; Hey and Lambert, 1980; Ebert and Moyes, 2000; Bossert and D'Ambrosio, 2006; Stark and Hyll, 2011).

    The pioneering study in modern times that opened the flood-gates to research on *RD* and primary (reference) groups is the 1949 two-volume set of Stouffer *et al.* *Studies in Social Psychology in World War II: The American Soldier.* That work documented the distress caused not by a given low military rank and weak prospects of promotion (military police) but rather by the pace of promotion of others (air force). It also documented the lesser dissatisfaction of black soldiers stationed in the South who compared themselves with black civilians in the South than the dissatisfaction of their counterparts stationed in the North who compared themselves with black civilians in the North. Stouffer's research was followed by a large social-psychological literature. Economics has caught up relatively late, and only somewhat. This is rather surprising because eminent economists in the past understood well that people compare themselves to others around them, and that social comparisons are of paramount importance for individuals' happiness, motivation, and actions. Even Adam Smith (1776) pointed to the social aspects of the necessities of life, and stressed the *relative* nature of poverty: "A linen shirt, for example, is, strictly speaking, not a necessary of life. The Greeks and Romans lived, I suppose, very comfortably, though they had no linen. But in the present times, through the greater part of Europe, a creditable day-laborer would be ashamed to appear in public without a linen shirt, the want of which would be supposed to denote that disgraceful degree of poverty [...]" (p. 465). Marx's (1849) observations that "Our wants and pleasures have their origin in the society; [... and] they are of a relative nature" (p. 33) emphasize the social nature of utility, and the impact of an individual's relative position on his satisfaction. Inter alia, Marx wrote: "A house may be large or small; as long as the surrounding houses are equally small, it satisfies all social demands for a dwelling. But if a palace arises beside the little house, the house shrinks into a hut" (p. 33). Samuelson (1973), one of the founders of modern neoclassical economics, pointed out that an individual's utility does not depend only on what he consumes in *absolute* terms: "Because man is a social animal, what he regards as 'necessary comforts of life' depends on what he sees others consuming" (p. 218).

---

[2] In Runciman's (1966) theory of *RD*, an individual's reference group is the group of individuals with whom the individual compares himself (cf. Singer, 1981).

The relative income hypothesis, formulated by Duesenberry (1949), posits an asymmetry in the comparisons of income which affect the individual's behavior: the individual looks upward when making comparisons. Veblen's (1899) concept of *pecuniary emulation* explains why the behavior of an individual can be influenced by comparisons with the incomes of those who are richer. Because income determines the level of consumption, higher income levels may be the focus for emulation. Thus, an individual's income aspirations (to obtain the income levels of other individuals whose incomes are higher than his own) are shaped by the perceived consumption standards of the richer individuals. In that way, invidious comparisons affect behavior, that is, behavior which leads to "the achievement of a favourable comparison with other men [...]" (Veblen, 1899, p. 33).[3]

2.2 *The rationale and construction of a measure of social stress*

Several recent insightful studies in social psychology (for example, Callan *et al.*, 2011; Smith *et al.*, 2012) document how sensing *RD* impacts negatively on personal wellbeing, but these studies do not provide a calibrating procedure; a sign is not a magnitude. For the purpose of constructing a measure, a natural starting point is the work of Runciman (1966), who, as already noted in the preceding sub-section, argued that an individual has an unpleasant sense of being relatively deprived when he lacks a desired good and perceives that others with whom he naturally compares himself possess that good. Runciman (1966, p. 19) writes as follows: "The more people a man sees promoted when he is not promoted himself, the more people he may compare himself with in a situation where the comparison will make him feel deprived," thus implying that the deprivation from not having, say, income y is an increasing function of the fraction of people in the individual's reference group who have y. To aid intuition and for the sake of concreteness, we resort to income-based comparisons, namely an individual feels relatively deprived when others in his comparison group earn more than he does. An implicit assumption here is that the earnings of others are publicly known. Alternatively, we can think of consumption, which might be more publicly visible than income, although these two variables can reasonably be assumed to be strongly positively correlated.

Let $y = (y_1, ..., y_m)$ be the vector of incomes in population N of size n with relative incidences $p(y) = (p(y_1), ..., p(y_m))$, where $m \leq n$ is the number of distinct income levels in y. The RD of an individual earning y_i is defined as the weighted sum of the excesses of incomes higher than y_i such that each excess is weighted by its relative incidence, namely

---

[3] The empirical findings support the relative income hypothesis. Duesenberry (1949) found that individuals' savings rates depend on their positions in the income distribution, and that the incomes of the richer people affect the behavior of the poorer ones (but not *vice versa*). Schor (1998) showed that, keeping annual and permanent income constant, individuals whose incomes are lower than the incomes of others in their community save significantly less than those in their community who are relatively better off.

$$RD_N(y_i) \equiv \sum_{y_k > y_i} p(y_k)(y_k - y_i). \qquad (1)$$

We expand the vector y to include incomes with their possible respective repetitions, that is, we include each y_i as many times as its incidence dictates, and we assume that the incomes are ordered, that is, $y = (y_1, ..., y_n)$ such that $y_1 \le y_2 \le ... \le y_n$. In this case, the relative incidence of each y_i, $p(y_i)$, is $1/n$, and $RD_N(y_i) \equiv \sum_{y_k > y_i} p(y_k)(y_k - y_i)$, defined for $i = 1, ..., n-1$, becomes

$$RD_N(y_i) \equiv \frac{1}{n} \sum_{k=i+1}^{n} (y_k - y_i).$$

Looking at incomes in a large population, we can model the distribution of incomes as a random variable Y over the domain $[0, \infty)$ with a cumulative distribution function F. We can then express the RD of an individual earning y_i as

$$RD_N(y_i) = [1 - F(y_i)] \cdot E(Y - y_i | Y > y_i). \qquad (2)$$

To obtain this expression, starting from (1), we have that

$$
\begin{aligned}
RD_N(y_i) &\equiv \sum_{y_k > y_i} p(y_k)(y_k - y_i) \\
&= \sum_{y_k > y_i} p(y_k)y_k - y_i \sum_{y_k > y_i} p(y_k) \\
&= [1 - F(y_i)] \sum_{y_k > y_i} \frac{p(y_k)y_k}{[1 - F(y_i)]} - y_i[1 - F(y_i)] \\
&= [1 - F(y_i)]E(Y | Y > y_i) - [1 - F(y_i)]y_i \\
&= [1 - F(y_i)]E(Y - y_i | Y > y_i).
\end{aligned}
$$

The formula in (2) states that the RD of an individual whose income is y_i is equal to the product of two terms: $1 - F(y_i)$, which is the fraction of those individuals in the population of n individuals whose incomes are higher than y_i, and $E(Y - y_i | Y > y_i)$, which is the mean excess income.

The formula in (2) is quite revealing because it casts RD in a richer light than the ordinal measure of rank or, for that matter, even the ordinal measure of status, which have been studied intensively in sociology and beyond. The formula informs us that when the income of individual A is, say, 10, and that of individual B is, say, 16, the RD of individual A is higher than when the income of individual B is 15, even though, in both cases, the rank of individual A in the income hierarchy is second. The formula also informs us that more RD is sensed by an individual whose income is 10 when the income of another is 14 (RD is 2)

than when the income of each of four others is 11 (*RD* is 4/5), even though the excess income in both cases is 4. This property aligns nicely with intuition: it is more painful (more stress is experienced) when the income of half of the population in question is 40 percent higher, than when the income of 4/5 of the population is 10 percent higher. In addition, the formula in (2) reveals that even though *RD* is sensed by looking to the right of the income distribution, it is impacted by events taking place on the left of the income distribution. For example, an exit from the population of a low-income individual increases the *RD* of higher-income individuals (other than the richest) because the weight that the latter attach to the difference between the incomes of individuals richer than themselves and their own income rises.

Similar reasoning can explain the demand for positional goods (Hirsch, 1976). The standard explanation is that this demand arises from the unique value of positional goods in elevating the social status of their owners ("These goods [are] sought after because they compare favorably with others in their class." Frank, 1985, p. 7). The distaste for relative deprivation offers another explanation: by acquiring a positional good, an individual shields himself from being leapfrogged by others which, if that were to happen, would expose him to *RD*. Seen this way, a positional good is a form of insurance against experiencing *RD*.

3. Methodological considerations

3.1 Differentiating between relative deprivation, poverty, and inequality

An individual can be poor without being relatively poor (relatively deprived) when his income is low while the incomes of other individuals in his reference (comparison) group are not higher than his; an individual can be both poor and relatively poor (relatively deprived) when his income is low while the incomes of other individuals in his reference group are higher than his.

The standard measure of aggregate relative deprivation used in this paper is distinct from the standard measure of inequality. To see this vividly, we can look at two income distributions: (2, 4) and (4, 8). If inequality is measured by the Gini coefficient, then there is no difference in this regard between the two populations; the Gini coefficient is the same at 1/6. However, the aggregate relative deprivation in income distribution (2, 4) at 1 is lower than the aggregate relative deprivation in income distribution (4, 8) at 2.

The dismay that arises from relative deprivation can drive a wedge between a transfer of income aimed at reducing poverty and a reduction of income inequality. Sorger and Stark (2013) and Stark *et al*. (2018) have shown that rich-to-poor transfer can induce a response in individuals' behaviors which actually exacerbates, rather than reduces, income inequality as measured by the Gini coefficient. The mechanism at work is as follows. Consider an economy in which two individuals

produce a single consumption good. The utility of each individual depends negatively on his work effort and on his (distaste for) relative deprivation (low relative income), and positively on his consumption. In such a constellation, a Pigou-Dalton transfer from a richer individual to a poorer one weakens the latter's incentive to work hard because the income deprivation experienced by the poorer individual is reduced. This scaling back of effort arises because, fundamentally, the poorer individual seeks income for two reasons: to obtain income "for its own sake," and to obtain income in order to hold at bay relative deprivation. When income is taken away from the richer individual, the relative deprivation sensed by the poorer individual is reduced, and his incentive to work to maintain a "bearable level" of relative deprivation is correspondingly weakened. Add to this the additional reduction in relative deprivation of the poorer individual by receiving that very income that is taken away from the richer individual. In this simple case of two individuals, it is obvious that the transfer reduces total relative deprivation. It is reasonable to suppose that the richer individual adjusts his working time (effort) so that he will not experience as great a reduction in income as has been taken away from him, but so that the adjustment falls short of neutralizing the (negative) transfer. The poorer individual will surely scale back his working time. In combination the two individuals working less than before implies that the sum of their incomes is smaller than the corresponding pre-transfer value. If the reduction in total income dominates the reduction in total deprivation, income inequality as measured by the Gini coefficient will worsen.

3.2 Complementary stress-related considerations

In order to better understand why the measure of relative deprivation used in this paper represents the stress that individuals experience when they compare their income with other individuals in their reference group, we can refer to writings that supplement the ones referred to in the preceding sub-section. Scholars both in economics and in sociology have long maintained that individuals have a strong preference for high (social) rank, and are stressed when they have low (social) rank. Smith has remarked that "the desire of ... obtaining rank among our equals, is, perhaps, the strongest of all our desires" (Smith, 1759, Part VI, Section I, Paragraph 4). Veblen (1899) has shown that other people's higher pay can depress one's utility. Maslow (1943) views status as a basic human need, and Huberman *et al*. (2004, p. 103) infer from a study of five societies that "subjects valued status independently of any monetary consequence." There is considerable evidence from research in modern economics showing that the desire to escape low rank motivates workers to exert more effort (Neckermann and Frey, 2008; Kuhnen and Tymula, 2009; Duffy and Kornienko, 2010; Kosfeld and Neckermann, 2011) and students to perform better (Bandiera *et al*., 2009; Azmat and Iriberri, 2010). A "problem" with this body of work is that, essentially, it points to an ordinal measure of relative deprivation, namely concern about having low rank. The measure used in this paper is cardinal.

Thus, there are apparently two strands in the literature, which gives rise to two alternative ways of measuring an individual's social stress: from occupying a low rank, and from experiencing an income shortfall. We have however found a way to show that the two perspectives are actually incorporated in the measure used in the paper. To see this, we express $RD_N(y_i)$ from the preceding sub-section as

$$RD_N(y_i) = \frac{n-i}{n}\left[\frac{1}{n-i}\sum_{j=i+1}^{n}(y_j - y_i)\right] = \frac{n-i}{n}\left(\frac{\sum_{j=i+1}^{n}y_j}{n-i} - w_i\right) = \frac{n-i}{n}\left(\tilde{y}_i - y_i\right)$$

where $\tilde{y}_i \equiv \dfrac{1}{n-i}\sum_{j=i+1}^{n}y_j$ is the average income of the individuals who are positioned to the right of individual i in the income distribution. We can decompose this representation of $RD_N(y_i)$ in the following manner:

$$RD_N(y_i) = (n-i)\left[\frac{1}{n}\left(\tilde{y}_i - y_i\right)\right].$$

The term $n - i$ expresses the distance in rank of individual i from the top rank, where "distance" is measured by the number of ranks higher up. Seen this way, the measure of relative deprivation used in this paper has a pure rank preferences component embedded in it, and a cardinal preferences component. This is revealing in the sense that the distress from trailing behind others can be decomposed into the distress from occupying a rank other than the top rank, measured by $n - i$, and the distress arising from a positive magnitude of income difference between the higher incomes of others and one's own income.

A simple numerical example of the tradeoff offered by this decomposition is as follows: let the income distribution be $\{1, 2, 3, 4, 5\}$. The rank deprivation of the individual earning 3 is two, the cardinal component of his relative deprivation is $3/10$, and his relative deprivation is $3/5$. The individual can lose rank without experiencing greater relative deprivation. Suppose that individual 2 achieves an income increase of two units, which places him to the right of individual 3 in the income distribution. The ordinal component of the relative deprivation of individual 3 is affected, changing from two to three. If at the same time in which individual 2 gains two units of income, individual 5 loses one unit of income, individual 3 remains equally relatively deprived at $3(1/5)(4-3) = 3/5$.

Seen this way, the measure of aggregate social stress used in this paper embodies the joint concerns of the individuals about being low ranked and about being at a large distance from the incomes of higher income individuals.

3.3 Evidence linking stress with relative deprivation

Because in this paper we define social stress as the aggregate of the levels of stress of the individuals, we measure an individual's level of stress by an index of relative deprivation, and we quantify social stress by the aggregate relative deprivation, it is helpful to present evidence of a causal link between relative deprivation and stress.

Tung *et al*. (2012) found a strong physiological link between social status and stress. They conducted an experiment involving 49 female macaque monkeys, divided initially into 10 groups. Social status was manipulated by the order in which a female was introduced into a social group, given the empirically established fact that earlier introduction confers a higher rank. Even so, seven females changed rank within their groups; although rank hierarchies tend to be stable, ranking sometimes changes, particularly with the replacement of individuals within a group. Using a procedure in which subordination and dominance were experimentally assigned, Tung *et al*. tested for association between social rank and gene regulation. The underlying research question was whether subordination (the change from higher to lower social status) triggers a physiological response (stress). Out of 6,097 genes considered in each female, about 16% were rank-associated genes. The results were quite powerful: changes in social status mapped onto gene expression of rank-related genes such that lower status resulted in greater stress and compromised immunity. In addition, the experiment by Tung *et al*. revealed that the physiological repercussions associated with social rank changed rapidly when social rank was revised.

Zink *et al*. (2008) conducted a study of neural correlates associated with processing changes of social hierarchies in humans. Using functional magnetic resonance imaging in different experimental settings, Zink *et al*. found that when the hierarchical position of an individual decreases, brain activity is related, among other factors, to the processing of pain and frustration (activity in the anterior insula), and of social anxiety (activity in the amygdala).

Using data on deaths by suicide in the US so as to identify the importance of interpersonal comparisons and "relative status," Daly *et al*. (2013) found compelling evidence that individuals care not only about their own income but also about the income of others in their local area: Daly *et al*. showed that individual suicide risk rises with others' income. This finding was obtained using two separate and independent data sets, suggesting that it is not an artifact of a particular sample design of either data set. The finding is robust to alternative specifications and cannot be explained by geographical variation in suicide classification, cost of living, or access to emergency medical care. Specifically, treating suicide as a choice variable regarding current life satisfaction and assessed value of future life, Daly *et al*. examined the relationship between suicide risk and one's own and others' income, using data from two independent sources: the National Longitudinal Mortality Study (NLMS) and data from publicly available death certificates combined with the 5% Public Use Micro Sample (PUMS) of the 1990 decennial

census. Holding an individual's income constant, they found that others' income, measured by local area (county) median income, was positively and significantly correlated with suicide risk. The relative income association holds for individuals across the income distribution, suggesting that suicide risk rises with median county income for both high-income and low-income individuals. That the finding applies also to high-income individuals emphasizes that absolute income per se does not shield an individual from feeling relative deprivation. The finding is consistent with the idea that relative deprivation, rather than one's own absolute income, matters for wellbeing (happiness), and that the stress it causes can be severe enough to make people take their own life.

The considerations brought up in the preceding two sub-sections pave the way to the construction of a model that enables us to inquire how the social stress of farmers, quantified by aggregate relative deprivation, changes when fellow farmers leave the agricultural sector in the course of structural change.

4. A model of change in the aggregate social stress of the farming population in the wake of structural change

Let there be a population of size n, consisting of m farmers and $n - m$ industry and services workers where m and n are both positive integers, $n - m > 0$, and let $m > n - m$. (As remarked in the Introduction, "initially the majority of the population works in farming.") In period 0, every farmer has income x_0, and every worker in industry and services has income z_0, where $z_0 > x_0 > 0$. As a measure of the social stress of a farmer we use the standard index of relative deprivation (RD).

Thus, the relative deprivation (social stress) experienced in period 0 by one of the m farmers is

$$RD_m = \frac{1}{n}(n - m)(z_0 - x_0).$$

The aggregate social stress of the m farmers, expressed as their aggregate relative deprivation (ARD), that is, as the sum of their levels of relative deprivation is

$$ARD_m = m\frac{1}{n}(n - m)(z_0 - x_0).$$

Suppose that in period 1, the following changes take place: the income of every farmer grows to x_1; the income of every worker in industry and services grows to z_1, where $z_1 > x_1$; and k farmers, where $0 < k < m$, leave the farming sector to become industrial and services workers, obtaining there income z_1. Then, the relative deprivation of one of the remaining $m - k$ farmers is

$$RD_{m-k} = \frac{1}{n}[n - (m - k)](z_1 - x_1),$$

and the aggregate relative deprivation experienced by the $m - k$ farmers is

$$ARD_{m-k} = (m - k)\frac{1}{n}[n - (m - k)](z_1 - x_1).$$

The difference between the aggregate relative deprivation of the farmers in period 1 and the aggregate relative deprivation of the farmers in period 0 is

$$\Delta ARD = (m - k)\frac{1}{n}[n - (m - k)](z_1 - x_1) - m\frac{1}{n}(n - m)(z_0 - x_0),$$

which can be rewritten as

$$\Delta ARD = \frac{1}{n}m(n - m)[(z_1 - x_1) - (z_0 - x_0)] + \frac{1}{n}k(2m - n - k)(z_1 - x_1)$$
$$= \Delta ARD_I + \Delta ARD_S \tag{3}$$

where $\Delta ARD_I \equiv \frac{1}{n}m(n - m)[(z_1 - x_1) - (z_0 - x_0)]$, and $\Delta ARD_S \equiv \frac{1}{n}k(2m - n - k)(z_1 - x_1)$; the subscripts I and S stand for "income" and "structural," respectively. The term ΔARD_I reflects the *income gap effect*: this is the change in the aggregate relative deprivation of the farmers that arises as a result of the change in the difference (gap) between the incomes of the two groups of individuals in the population, and is independent of occupational migration, namely it holds even if no farmer switches to become a worker in industry and services in period 1. Because both n and m are positive and $n - m > 0$, the impact of the income gap effect on aggregate relative deprivation depends on the term in square-brackets in ΔARD_I. The sign of this term is determined by whether the gap between the income of a worker in industry and services and the income of a farmer widens or narrows between the two periods. This term can increase the aggregate relative deprivation of the farmers even when their incomes increase, yet the incomes of the workers in industry and services increase by more.

The term ΔARD_S reflects the *structural effect*: this is the change in the aggregate relative deprivation of the farmers that arises from occupational migration - a switch by k farmers to become workers in industry and services. Because $z_1 > x_1$ and because both n and k are positive, the sign of ΔARD_S depends on the sign of its first term in parentheses. We note that ΔARD_S can be positive even if there is no change in the incomes between the two periods (we note that, then, $z_1 - x_1$ can be replaced with $z_0 - x_0$ where, as assumed, $z_0 > x_0$). In particular, $\Delta ARD_S > 0$ if and only if

$$k < 2m - n \tag{4}$$

or, equivalently, if and only if

$$\frac{k}{n} < 2\left(\frac{m}{n} - \frac{1}{2}\right). \tag{5}$$

The condition in (5) can be interpreted as follows. The structural effect contributes to an increase of the aggregate relative deprivation of those who stay in farming if and only if the share of the population that changes occupation between period 0 and period 1 (namely $\frac{k}{n}$) is smaller than twice the difference $\frac{m}{n} - \frac{1}{2}$. In turn, this difference is the excess at the initial period 0 of the share of farmers in the population over one half. Thus, if the income gap effect is nil ($\Delta ARD_I = 0$), a necessary condition for the aggregate relative deprivation of the farmers to increase during structural change, as follows from (4), is that initially the majority of the population are farmers (otherwise, when $m < n - m$, the right-hand side of (4) will be smaller than 0, which contradicts the assumption of k being a positive integer; recall, though, that in the beginning of this section, it was assumed that $m > n - m$). From the definition of ΔARD_S, it also follows that if, in a sense made precise, the number of farmers who become workers in industry and services is large enough, namely if $k \geq 2m - n$ or, equivalently, if $\frac{k}{n} \geq 2\left(\frac{m}{n} - \frac{1}{2}\right)$, then the aggregate relative deprivation of the farmers will decrease when the income gap does not change. Expressing ΔARD_S as a function of k, we have that for values of k that are larger than $2m - n$, $\Delta ARD_S(k) < 0$, namely the structural component of social stress in period 1 is lower than the structural component of social stress in period 0. After all, when a good many farmers leave the farming sector, the few who are left behind do not experience enough combined stress that will match - let alone surpasses - the farmers' initial aggregate stress. And this is so in spite of the fact that each of the few farmers who stay behind is much more stressed as a result of a substantial increase in the share of workers in industry and services.

The relationship between the structural component of changes in aggregate relative deprivation, ΔARD_S, and k is illustrated in Figure 2, where ΔARD_S is plotted for different levels of k while holding m and n constant, and while assuming that $\frac{m}{n} > \frac{1}{2}$. From (4) we know that for $k > 0$, the function $\Delta ARD_S(k)$ is positive when k is smaller than $2m - n$. We also note that when $k \in (0, 2m - n)$, $\Delta ARD_S(k)$ increases for k between 0 and $m - \frac{n}{2}$, and decreases for k between $m - \frac{n}{2}$ and $2m - n$. The maximum of $\Delta ARD_S(k)$ at $k^* = m - \frac{n}{2}$ is obtained at a point in which the number of farmers, $m - k^* = m - \left(m - \frac{n}{2}\right) = \frac{n}{2}$, is equal to the number of industrial and service

**Figure 2. The effect of occupational migration on aggregate relative deprivation -
the structural component.**
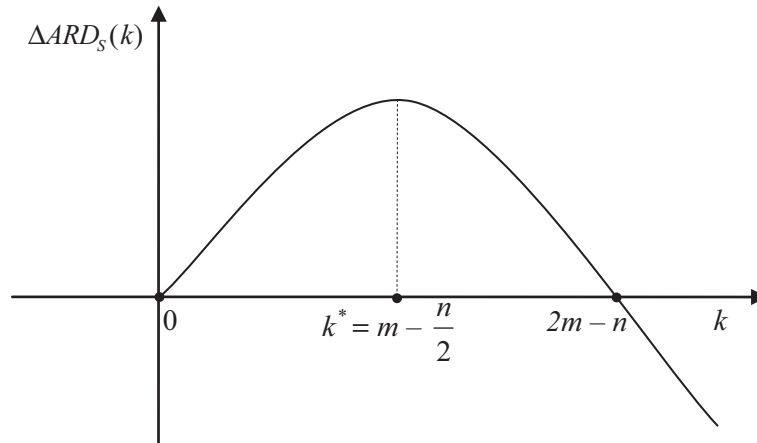
workers. And the point in which $\Delta ARD_S(k)$ subsequently crosses zero ($k = 2m - n$) is the exact opposite of the initial shares of farmers and industrial and service workers in the population: when $\Delta ARD_S(k) = 0$, there are $m - k = m - (2m - n) = n - m$ farmers and $(n - m) + k = (n - m) + (2m - n) = m$ industrial and service workers.

5. Policy-related implications of the model

Drawing on the preceding considerations, we can place a precise cap on the "justified" support for the farm sector. To this end, we review a structural change in the economy such that $\Delta ARD_S(k) > 0$ holding, for now, the incomes of farmers and the incomes of workers in industry and services constant between the prior-to-migration period and the migration period. That is, we assume a nil income gap effect on aggregate relative deprivation. Thus, the entire change in aggregate relative deprivation in the course of structural change, if it occurs, is related to the structural effect attributable to occupational migration. Specifically, we ask what the minimal level of the support for farmers during the structural change should be such that their *ARD* will be retained at the same level as prior to the structural change. In other words, we are interested in calculating the subsidy s for which the incomes of farmers, x_1, expressed as $x_0 + s$, yields $\Delta ARD = 0$.

Assuming that the incomes of workers in industry and services and the incomes of farmers are held constant, the policy-related requirement of $0 = \Delta ARD$ is equivalent to the requirement

$$0 = \frac{1}{n} m(n - m)[(z_1 - x_1) - (z_0 - x_0)] + \frac{1}{n} k(2m - n - k)(z_1 - x_1)$$
$$= \frac{1}{n} m(n - m)[(z_0 - x_1) - (z_0 - x_0)] + \frac{1}{n} k(2m - n - k)(z_0 - x_1)$$
$$= \frac{1}{n} m(n - m)(x_0 - x_1) + \frac{1}{n} k(2m - n - k)(z_0 - x_1),$$

which, solving for x_1, yields

$$x_1^* = \frac{m(n - m)x_0 + k(2m - n - k)z_0}{m(n - m) + k(2m - n - k)}.$$

Given that x_1 can be represented as $x_0 + s$, the formula for x_1^* allows us to calculate the optimal subsidy which is equal to

$$s^* = \frac{k(2m - n - k)(z_0 - x_0)}{m(n - m) + k(2m - n - k)}.$$

When we relax the assumption that the incomes of workers in industry and services are held constant and allow these incomes to increase as the structural change progresses, that is, if $z_1 > z_0$, then the requirement of $0 = \Delta ARD$, namely

$$0 = \frac{1}{n} m(n - m)[(z_1 - x_1) - (z_0 - x_0)] + \frac{1}{n} k(2m - n - k)(z_1 - x_1), \tag{6}$$

yields

$$x_1^{**} = z_1 - \frac{m(n - m)(z_0 - x_0)}{m(n - m) + k(2m - n - k)}.$$

Thus, when in the course of structural change the incomes of workers in industry and services increase, the incomes of farmers have to be raised to x_1^{**} in order to keep their *ARD* in check. Solving for the corresponding optimal subsidy (namely upon expressing x_1 as $x_0 + s$) yields

$$s^{**} = z_1 - \frac{k(2m - n - k)x_0 + m(n - m)z_0}{m(n - m) + k(2m - n - k)}.$$

Rearranging (6), we get that

$$(x_1 - x_0) - (z_1 - z_0) = \frac{k(2m - n - k)}{m(n - m)}(z_1 - x_1). \tag{7}$$

The representation in (7) illustrates an intuitive implication of our model: if the structural effect contributes to an increase in the aggregate relative deprivation of

farmers (which is the case if and only if (4) holds, namely if and only if $k < 2m - n$), and when no subsidies are disbursed, then the increase in the incomes of farmers has to be bigger than the increase in the incomes of workers in industry and services for the aggregate relative deprivation of farmers to remain constant (recalling that $z_1 - x_1 > 0$).

In numerous countries, governments express concern about the welfare of the farming population, and quite often take a range of steps to provide financial support for the farming population. In order to maintain the wellbeing of the farmers in the course of structural change, a question to address is precisely what support to provide. The calculation above of s^{**} identifies a concrete amount and, as such, offers a policy-related innovation in contexts in which specific bounds are absent.

The analysis in this paper complements related work by Stark and Zawojska (2016) who study policy responses to an increase in post-merger social stress. If a merger of groups of people is viewed as a change to their social space, then the merger alters people's comparators and increases social stress: the social stress of a merged population is greater than the sum of the levels of social stress of the constituent populations when separate. Stark and Zawojska use social stress as a proxy measure for impending social protest. As a response to a post-merger increase in social stress, they consider a policy aimed at reversing the negative effect of the merger by bringing the social stress of the merged population back to the sum of the pre-merger levels. Stark and Zawojska present, in the form of an algorithm, a cost-effective policy response which is publicly financed and does not reduce the incomes of the members of the merged population. Stark and Zawojska then compare the financial cost of implementing such a policy when the merger involves more groups. A surprising result reported by Stark and Zawojska is that the minimum sums required for keeping the post-merger level of social stress at its pre-merger level may decrease as the number of integrating groups involved increases. In the current paper we ask how to tailor support, here for farmers during the structural change, so that their level of social stress will be contained. The analysis undertaken in the current paper is innovative in that it introduces a new perspective: the question addressed is not how to respond to a change in social stress arising from the integration of more groups but rather how to respond to increased social stress in a shrinking group.

6. Conclusions

The topic of agricultural protection continues to occupy a prominent place in political economy and development economics agendas. An observation related to this subject is that while countries develop economically, they gradually move from taxing to cushioning their farming sector. It has been argued that a rise in the inter-sectoral income disparity that often accompanies structural change plays the

key role in this regard. We show that this does not need to be the case: farmers can have a "justifiable case" to lobby for support even when the inter-sectoral income gap remains constant. Structural change involves a shift of employment from farming to other sectors. Provided that the outflow from the agricultural sector is not too large, the aggregate social stress of those who stay in the farming sector can increase. And increased stress can strengthen the demand for relief.

To best of our knowledge, this line of reasoning has not been alluded to elsewhere. In this regard, the present paper complements the received writings that have focused either on farmers' support or on structural change. As already noted in Section 5, the implications of the model are of relevance for policymakers, should they be interested in effectively alleviating the aggregate stress of the farming population in the course of structural change.

Although it would be useful to supplement this paper with an empirical inquiry, at this stage we did not do so. The main reason for this is that the data sources currently available to us are not adequate for conducting such an inquiry. Verification of our model will require detailed data at household-level (if not at individual-level) not only about the farmers themselves, but also about the reference group of the farmers. In addition, the data will have to allow us to identify transitions from agricultural to non-agricultural sectors and, therefore, provide information for at least two points in time. Nonetheless, we are contemplating a future study in order to meet this challenge, and we have in mind a number of possibilities. In several countries there are political parties that have vehemently promoted the interests of farmers. For example, in Poland, at the beginning of the transformation period, farmers aligned themselves with and formed the backbone of the Polish Peasant Party, PSL. Although the PSL consistently campaigned in favor of continued support for farmers, it had different degrees of support in different agricultural municipalities as they experienced an uneven pace of transformation. If detailed data could be procured on the variation in the intensity of support for the PSL among the farming population as a proxy of "social anger," together with data on "exits" from the farming sector in given municipalities, then it would be possible to offer a discussion of the empirical validity of the model's predictions.

References

Anderson, K., Croser, J., Sandri, D. and Valenzuela, E. (2010). 'Agricultural distortion patterns since the 1950s: What needs explaining?', in Anderson, K. (ed.), *Political Economy of Distortions to Agricultural Incentives*, Cambridge and New York: Cambridge University Press, pp. 25–80.

Anderson, K., Hayami, Y. and Honma, M. (1986). 'The growth of agricultural protection', in Anderson, K. and Hayami, Y. (eds.), *Political Economy of Agricultural Protection: East Asia in International Perspective*, Boston, London, Sydney: Allen and Unwin, pp. 17–30.

Anderson, K., Rausser, G. and Swinnen, J. (2013). 'Political economy of public policies: Insights from distortions to agricultural and food markets', *Journal of Economic Literature*, 51(2), pp. 423–477.

Azmat, G. and Iriberri, N. (2010). 'The importance of relative performance feedback information: Evidence from a natural experiment using high school students', *Journal of Public Economics*, 94(7–8), pp. 435–452.

Bandiera, O., Larcinese, V. and Rasul, I. (2009). 'Blissful ignorance? Evidence from a natural experiment: On the effect of individual feedback on performance', mimeo, London School of Economics.

Barrett, C. (1999). 'The microeconomics of the developmental paradox: On the political economy of food price policy', *Agricultural Economics*, 20(2), pp. 159–172.

Bossert, W. and D'Ambrosio, C. (2006). 'Reference groups and relative deprivation', *Economics Letters*, 90(3), pp. 421–426.

Callan, M. J., Shead, W. N. and Olson, J. M. (2011). 'Personal relative deprivation, delay discounting, and gambling', *Journal of Personality and Social Psychology*, 101(5), pp. 955–973.

Caselli, F. and Coleman, W. J. (2001). 'The U.S. structural transformation and regional convergence', *Journal of Political Economy*, 109, pp. 584–616.

Clark, A. E., Frijters, P. and Shields, M. A. (2008). 'Relative income, happiness, and utility: An explanation for the Easterlin paradox and other puzzles', *Journal of Economic Literature*, 46(1), pp. 95–144.

Cornia, G. A. and Kiiski, S. (2001). 'Trends in income distribution in the post-World War II period. Evidence and interpretation', Helsinki: WIDER Working Paper 89/2001, UNU/WIDER, https://www.wider.unu.edu/sites/default/files/dp2001-89.pdf

Daly, M. C., Wilson, D. J. and Johnson, N. J. (2013). 'Relative status and well-being: Evidence from U.S. suicide deaths', *Review of Economics and Statistics*, 95(5), pp. 1480–1500.

de Gorter, H. and Swinnen, J. F. M. (2002). 'Political economy of agricultural policies', in Gardner, B. and Rausser, G. (eds.), *Handbook of Agricultural Economics*, Vol. 2, Amsterdam: Elsevier Science, pp. 2073–2123.

Duesenberry, J. S. (1949). *Income, Saving and the Theory of Consumer Behavior*, Cambridge, MA: Harvard University Press.

Duffy, J. and Kornienko, T. (2010). 'Does competition affect giving?', *Journal of Economic Behavior and Organization*, 74(1–2), pp. 82–103.

Eastwood, R. and Lipton, M. (2000). 'Rural-urban dimension of inequality change', Helsinki: WIDER Working Paper No. 200/2000, UNU/WIDER,
https://www.wider.unu.edu/sites/default/files/wp200.pdf

Ebert, U. and Moyes, P. (2000). 'An axiomatic characterization of Yitzhaki's index of individual deprivation', *Economics Letters*, 68(3), pp. 263–270.

Frank, R. H. (1985). *Choosing the Right Pond: Human Behavior and the Quest for Status*, New York: Oxford University Press.

Herrendorf, B., Rogerson, R. and Valentinyi, A. (2014). 'Growth and structural transformation', in Aghion, P. and Durlauf, S. (eds.), *Handbook of Economic Growth*, Vol. 2B, Amsterdam: Elsevier Science, pp. 855–941.

Hey, J. D. and Lambert, P. J. (1980). 'Relative deprivation and the Gini coefficient: Comment', *Quarterly Journal of Economics*, 95(3), pp. 567–573.

Hirsch, F. (1976). *Social Limits to Growth*, Cambridge, MA: Harvard University Press.

Huberman, B. A., Loch, C. H. and Önçüler, A. (2004). 'Status as a valued resource', *Social Psychology Quarterly*, 67(1), pp. 103–114.

Johnston, B. and Mellor, J. (1961). 'The role of agriculture in economic development', *American Economic Review*, 51(4), pp. 566–593.

Jorgenson, D. W. and Timmer, M. P. (2011). 'Structural change in advanced nations: A new set of stylised facts', *Scandinavian Journal of Economics*, 113(1), pp. 1–29.

Kosfeld, M. and Neckermann, S. (2011). 'Getting more work for nothing? Symbolic awards and worker performance', *American Economic Journal: Microeconomics*, 3(3), pp. 86–99.

Kuhnen, C. and Tymula, A. (2009). 'Rank expectations, feedback and social hierarchies', mimeo, Northwestern University.

Kuznets, S. (1966). *Modern Economic Growth*, New Haven, CT: Yale University Press.

Lewis, W. A. (1954). 'Economic development with unlimited supplies of labour', *The Manchester School*, 22(2), pp. 139–191.

Lindert, P. H. (1991). 'Historical Patterns in Agricultural Policy', in Timmer, C. P. (ed.), *Agriculture and the State*, Ithaca: Cornell University Press, pp. 23–92.

Marx, K. (1849). *Wage-Labour and Capital*, New York: International Publishers, 1933.

Maslow, A. H. (1943). 'A theory of human motivation', *Psychological Review*, 50(4), pp. 370–396.

Matsuyama, K. (2008). 'Structural change', in Durlauf, S. N. and Blume, L. E. (eds.), *The New Palgrave Dictionary of Economics*, Vol. 8, New York: Macmillan. Second ed., pp. 52–55.

Neckermann, S. and Frey, B. S. (2008). 'Awards as incentives', University of Zurich, IEW Working Paper No. 335, http://www.econ.uzh.ch/static/wp_iew/iewwp334.pdf

Nedergaard, P. (2006). 'Market failures and government failures: A theoretical model of the Common Agricultural Policy', *Public Choice*, 127, pp. 393–413.

Olson, M. (1965). *The Logic of Collective Action: Public Goods and the Theory of Groups*, Cambridge, MA: Harvard University Press.

Paarlberg, R. (2013). *Food Politics: What Everyone Needs to Know*, New York: Oxford University Press. Second ed.

Runciman, W. G. (1966). *Relative Deprivation and Social Justice*, Berkeley: University of California Press.

Salhofer, K., Hofreither, M. F. and Sinabell, F. (2000). 'Promotion of the agricultural sector and political power in Austria', *Public Choice*, 102, pp. 229–246.

Samuelson, P. A. (1973). *Economics*, New York: McGraw-Hill. Ninth ed.

Schor, J. B. (1998). *The Overspent American: Why We Want What We Don't Need*, New York: Basic Books.

Singer, E. (1981). 'Reference groups and social evaluations', in Rosenberg, M. and Turner, R. H. (eds.), *Social Psychology: Sociological Perspectives*, New York: Basic Books, pp. 66–93.

Smith, A. (1759). *The Theory of Moral Sentiments*, London: A. Millar.

Smith, A. (1776). *The Wealth of Nations*, Book V, Chapter 2, London: Penguin Classics, 1999.

Smith, H. J., Pettigrew, T. F., Pippin, G. M. and Bialosiewicz, S. (2012). 'Relative deprivation: A theoretical and meta-analytic review', *Personality and Social Psychology Review*, 16(3), pp. 203–232.

Sorger, G. and Stark, O. (2013). 'Income redistribution going awry: The reversal power of the concern for relative deprivation', *Journal of Economic Behavior and Organization*, 86, pp. 1–9.

Spoor, M. (ed.) (2009). *The Political Economy of Rural Livelihoods in Transition Economies: Land, Peasants and Rural Poverty in Transition*, London: Routledge.

Stark, O. and Hyll, W. (2011). 'On the economic architecture of the workplace: Repercussions of social comparisons among heterogeneous workers', *Journal of Labor Economics*, 29(2), pp. 349–375.

Stark, O., Kosiorowski, G. and Jakubek, M. (2018). 'An adverse social welfare consequence of a rich-to-poor income transfer: A relative deprivation approach', in Sanghamitra, B. (ed.), *Research on Economic Inequality*, Vol. 25, Bingley: Emerald, pp. 1–37.

Stark, O. and Zawojska, E. (2016). 'Will a government find it financially easier to neutralize a looming protest if more groups are involved?', *Constitutional Political Economy*, 27, pp. 435–450.

Stouffer, S. A., Suchman, E. A., DeVinney, L. C., Star, S. A. and Williams Jr., R. M. (1949). *The American Soldier: Adjustment During Army Life*, Vol. I. Stouffer, S. A., Lumsdaine, A. A., Lumsdaine, M. H., Williams Jr., R. M., Smith, B. M., Janis, I. L., Star, S. A. and Cottrell Jr., L. S. *The American Soldier: Combat and its Aftermath*, Vol. II. Studies in Social Psychology in World War II, Princeton: Princeton University Press.

Swinnen, J. F. M. (1994). 'A positive theory of agricultural protection', *American Journal of Agricultural Economics*, 76(1), pp. 1–14.

Swinnen, J. F. M. (2009). 'Reforms, globalization, and endogenous agricultural structures', *Agricultural Economics*, 40(s1), pp. 719–732.

Swinnen, J. F. M. (2010). 'Agricultural protection growth in Europe, 1870-1969', in Anderson, K. (ed.), *Political Economy of Distortions to Agricultural Incentives*, Cambridge and New York: Cambridge University Press, pp. 141–161.

Timmer, M. P., de Vries, G. J. and de Vries, K. (2014). 'Patterns of structural change in developing countries', Groningen: University of Groningen, GGDC Research memorandum 149, https://www.rug.nl/ggdc/docs/gd149.pdf

Tung, J., Barreiro, L. B., Johnson, Z. P., Hansen, K. D., Michopoulos, V., Toufexis, D., Michelini, K., Wilson, M. E. and Gilad, Y. (2012). 'Social environment is associated with gene regulatory variation in the rhesus macaque immune system', *Proceedings of the National Academy of Sciences*, 109(17), pp. 6490–6495.

Veblen, T. (1899). *The Theory of the Leisure Class,* Reprints of Economic Classics: New York: Augustus M. Kelley, 1965.

Yitzhaki, S. (1979). 'Relative deprivation and the Gini coefficient', *Quarterly Journal of Economics*, 93(2), pp. 321–324.

Zink, C. F., Tong, Y., Chen, Q., Bassett, D. S., Stein, J. L. and Meyer-Lindenberg, A. (2008). 'Know your place: Neural processing of social hierarchy in humans', *Neuron*, 58(2), pp. 273–283.