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Gainers and Losers from Trade Reform in Morocco

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Abstract: We use Morocco's national survey of living standards to measure the short-term welfare impacts of prior estimates of the price changes attributed to various agricultural trade reform scenarios for de-protecting cereals — the country's main foodstaple. We find small impacts on mean consumption and inequality in the aggregate. There are both winners and losers and (contrary to past claims) the rural poor are worse off on average after de-protection. We decompose the aggregate impact on inequality into a "vertical" component (between people at different pre-reform welfare levels) and a "horizontal" component (between people at the same pre-reform welfare). There is a large horizontal component, which dominates the vertical impact of full de-protection. The diverse impacts reflect a degree of observable heterogeneity in consumption behavior and income sources, with implications for social protection policies.

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1. Introduction

As a water-scarce country, Morocco does not have much natural advantage in the production of water-intensive crops such as most cereals, including wheat, which is used to produce the country's main food staples. The desire for aggregate self-sufficiency in the production of food staples has led in the past to governmental efforts to foster domestic cereal production, even though cereals can be imported more cheaply. Since the 1980s, cereal producers have been protected by tariffs on imports as high as 100%.

There have been concerns that the consequent reallocation of resources has hurt consumers and constrained the growth of production and trade. Reform to the current incentive system for cereals has emerged as an important issue on the policy agenda for Morocco (World Bank, 2003). The major obstacles to reform stem from concerns about the impacts on household welfare, particularly for the poor. There has been very little careful research into who will gain and who will lose from such reforms.

Nonetheless, there has been much debate about the equity implications. It is generally agreed that urban consumers are likely to gain from lower cereal prices. More contentious are the welfare distributional impacts in rural areas. Defenders of the existing protection system have argued that there will be large welfare losses to the rural economy from trade reform. Critics have argued against this view, claiming that the bulk of the rural poor tend to be net consumers, and so lose out from the higher prices due to trade protection. They argue that the rural poor are likely to gain from the reform, while it will be the well off in rural areas who tend to be net producers who will lose; see for example, Abdelkhalek (2002) and World Bank (2003).

This paper studies the household welfare impacts of the relative price changes induced by specific trade policy reform scenarios for cereals in Morocco. Past analyses of the welfare

impacts have been highly aggregated, focusing on just one or a few categories of households. Here we estimate impacts across 5,000 sampled households in the Morocco Living Standards Survey for 1998/99. This allows us to provide a detailed picture of the welfare impacts, so as to better inform discussions of the social protection policy response to trade liberalization.

Past approaches to studying the welfare impacts of specific trade reforms have tended to be either partial equilibrium analyses, in which the welfare impacts of the direct price changes due to tariff changes are measured at household level, or general equilibrium analyses, in which second-round responses are captured in a theoretically consistent way but with considerable aggregation across household types. In general terms, the economics involved in both approaches is well known. And both approaches have found numerous applications.

We combine these two approaches. In particular, the price changes induced by the trade-policy change are simulated from a general equilibrium analysis done for a Joint Government of Morocco and World Bank Working Group. We take the methods and results of that analysis as given and carry them to the Moroccan Living Standards survey. Our approach respects the richness of detail available from a modern integrated household survey, allowing us to go well beyond the highly aggregative types of analysis one often finds. We not only measure expected impacts across the distribution of initial levels of living, but we also look at how they vary by other characteristics, such as location. We are thus able to provide a reasonably detailed "map" of the predicted welfare impacts by location and socio-economic characteristics.

In studying the distributional impacts of trade reform we make a distinction between the "vertical impact" and "horizontal impact." The former concerns the way the mean impacts vary with level of pre-reform income — how the reform affects people at different pre-reform incomes. The horizontal impact relates to the disparities in impact between people at the same

pre-reform income. As argued in Ravallion (2004), many past discussions of the distributional impacts of trade and other economy-wide reforms have tended to focus more on the vertical impacts, analogously to standard practices in studying the "benefit incidence" of tax and spending policies. However, as we will demonstrate here, this focus may well miss an important component of a policy's distributional impact, arising from the horizontal dispersion in impacts at given pre-reform incomes. We show how the impact of a policy on a standard inequality measure can be straightforwardly decomposed into its vertical and horizontal components. The former tells us how much of the change in total inequality can be accounted for by the way in which mean impacts conditional on pre-reform income vary with the latter. If there is no difference in the proportionate impact by level of income, then the vertical component is zero. The horizontal component tells us the contribution of the deviations in impacts from their conditional means. Only when the impact of the reform is predicted perfectly by pre-reform income will the horizontal component be zero. We study the relative importance of these two components of our predicted distributional impact of trade reform in Morocco.

The following section discusses our approach in general terms. Section 3 presents our results in detail, while section 4 reviews the main findings.

2. Measuring and explaining the welfare impacts of reform using micro data

We use pre-existing estimates of the household-level welfare impacts of the price changes generated by a computable general equilibrium (CGE) model. The CGE analysis generates a set of price changes; these embody both the direct price effects of the trade-policy change and indirect effects on the prices of both traded and non-traded goods once all markets respond to the reform. Standard methods of first-order welfare analysis are used to measure the gains and losses at household level.

Our focus here is very much on the short-term welfare impacts. In keeping with the limitations of the preceding general equilibrium analysis, our approach does not capture the dynamic effects of trade reform through labor market adjustment and technological innovation. Nor does it capture potential gains to the environment.[2]

The specifics of our approach to estimating welfare impacts at the household level can be outlined as follows.[3] Each household has preferences over consumption and work effort represented by the utility function $u_i(q_i^d, L_i)$ where q_i^d is a vector of the quantities of commodities demanded by household *i* and L_i is a vector of labor supplies by activity, including supply to the household's own production activities.[4] The household is assumed to be free to choose its preferred combinations of q_i^d and L_i subject to its budget constraint.

The household owns a production activity that generates a profit $\pi_i(p_i^s) = \max[p_i^s q_i^s - c_i(q_i^s)]$ where p_i^s is the vector of supply prices, and $c_i(q_i^s)$ is the household-specific cost function.[5] The indirect utility function of household *i* is given by:

$$v_i[p_i^s, p_i^d, w_i] = \max_{(q_i^d, L_i)} [u_i(q_i^d, L_i) \,|\, p_i^d q_i^d = w_i L_i + \pi_i(p_i^s)] \qquad (1)$$

where p_i^d is the price vector for consumption, w_i is the vector of wage rates.

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[2] Though it is not a subject of the present analysis, arguments are also made about adverse environmental impacts arising from the expansion of protected cereal production into marginal areas, It is claimed that scarce water resources have also been diverted into soft wheat production. For further discussion see World Bank (2003).

[3] There are many antecedents of our approach in the literatures on both tax reform and trade reform, though there are surprisingly few applications to point to in the *ex ante* assessment of actual reform proposals. For another example see Chen and Ravallion (2004). Hertel and Reimer (2004) provide a useful overview of the strengths and weaknesses of alternative approaches to assessing the welfare impacts of trade-policies, including references to empirical examples for developing countries.

[4] We make the standard assumptions that goods have positive marginal utilities while labor supplies have negative marginal utilities.

[5] On can readily include input prices in this cost function; see Chen and Ravallion (2004) for a more general formulation. In the present context this makes no difference to the subsequent analysis so we subsume factor prices in the cost function to simplify notation.

We take the predicted price impacts from the CGE model as given for the analysis of household-level impacts. In measuring the impacts we are constrained of course by the data, which do not include prices and wages. However, this limitation does not matter to calculating a first-order approximation to the welfare impact in a neighborhood of the household's optimum. Taking the differential of (1) and using the envelope property (whereby the welfare impacts in a neighborhood of an optimum can be evaluated by treating the quantity choices as given), the gain to household *i* (denoted g_i) is given by the money metric of the change in utility:

$$g_i \equiv \frac{du_i}{v_{\pi i}} = \sum_{j=1}^{m}[p_{ij}^s q_{ij}^s \frac{dp_{ij}^s}{p_{ij}^s} - p_{ij}^d q_{ij}^d \frac{dp_{ij}^d}{p_{ij}^d}] + \sum_{k=1}^{n}(w_k L_{ik}^s \frac{dw_k}{w_k}) \qquad (2)$$

where $v_{\pi i}$ is the marginal utility of income for household *i* (the multiplier on the budget constraint in equation 1) and L_{ik}^s is the household's "external" labor supply to activity *k*. (Notice that gains in earnings from labor used in own production are exactly matched by the higher cost of this input to own-production.) The proportionate changes in prices are weighted by their corresponding expenditure shares; the weight for the proportionate change in the *j*'th selling price is $p_{ij}^s q_{ij}^s$, the revenue (selling value) from household production activities in sector *j*; similarly $-p_{ij}^d q_{ij}^d$ is the (negative) weight for demand price changes and $w_k L_{ik}^s$ is the weight for changes in the wage rate for activity *k*. The term $p_{ij}^s q_{ij}^s - p_{ij}^d q_{ij}^d$ gives (to a first-order approximation) the welfare impact of an equi-proportionate increase in the price of commodity *j*.

Equation (2) is the key formula we will use for calculating the welfare impacts at household level, given the predicted price changes. In the specific model we will use (as discussed later), real wage rates are fixed. So the last term on the right hand side of (2) drops out. (We discuss likely implications of relaxing this assumption in section 3.5.)

Notice that by applying the calculus in deriving (2) we are implicitly assuming small changes in prices. Relaxing this requires more information on the structure of the demand and supply system; see for example Ravallion and van de Walle (1991). This would entail considerable further effort, and the reliability of the results will be questionable given the aforementioned problem of incomplete price and wage data. For the same reason, we will have little choice but to largely ignore geographic differences in the prices faced, or in the extent to which border price changes are passed on locally.

Having estimated the impacts at household level, we can study how they vary with pre-reform welfare, and what impact the reform has on poverty and inequality. Let y_i denote the pre-reform welfare per person in household *i* while $y_i^* = y_i + g_i$ is its post-reform value, where g_i is the gain to household *i*. (Ideally, y_i will be an exact money-metric of utility, though in practice it can be expected that it is an approximation given omitted prices or characteristics.) The distribution of post-reform welfare levels is $y_1^*, y_2^*, ...y_n^*$. By comparing standard summary measures of poverty or inequality for this distribution with those for the pre-reform distribution, $y_1, y_2, ...y_n$, we can assess overall impacts.

Of obvious interest is to see how the gains vary with pre-reform welfare. Is it the poor who tend to gain, or is it middle-income groups or the rich? However, it is important to recognize that the assignment of impacts to the pre-reform distribution is very unlikely to be a degenerate distribution, with no distribution of its own. There will almost certainly be a dispersion in impact at given pre-reform welfare. This will arise from (observable and unobservable) heterogeneity in characteristics and prices. It could also arise from errors in the

welfare measure. Averaging across the distribution of impacts at given pre-reform welfare, one can calculate the conditional mean impact given by:

$$g_i^c = E_i(g_i \mid y = y_i) \tag{3}$$

where the expectation is formed over the conditional distributions of impacts. By including a subscript *i* in the expectations operator in (3), we allow the possibility that the horizontal dispersion in impacts is not identically distributed. In our empirical implementation, equation (3) will be estimated using a non-parametric regression.

Taking these observations a step further, we can think of the overall impact on inequality as having both vertical and horizontal components.[6] This is straightforward for the mean log deviation (MLD) — an inequality measure known to have a number of desirable features.[7] The mean log deviation defined on the distribution of post-reform welfares $y_1^*, y_2^*, \ldots y_n^*$ is given by:

$$I^* = \frac{1}{n}\sum_{i=1}^{n} \ln(\bar{y}^* / y_i^*) \tag{4}$$

where $\bar{y}^* = \sum_{i=1}^{n} y_i^* / n$ is mean post-reform welfare. Similarly,

$$I = \frac{1}{n}\sum_{i=1}^{n} \ln(\bar{y} / y_i) \tag{5}$$

is the pre-reform MLD. (In both (4) and (5) it is assumed that $y_i > 0$ and $y_i^* > 0$ for all *i*. Thus $I^* - I$ is the change in inequality attributable to the reform. The proposed decomposition of the overall change in inequality can then be written as:

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[6] Antecedents to this type of decomposition can be found in the literature on horizontal equity in taxation. In the context of assessing a tax system, Auerbach and Hassett (2002) show how changes in an index of social welfare can be decomposed into terms reflecting changes in the level and distribution of income, the burden and progressivity of the tax system and a measure of the change in horizontal equity.

[7] For further discussion of the MLD see Bourguignon (1979) and Cowell (2000). MLD is a member of the General Entropy class of inequality measures.

$$I^* - I = \frac{1}{n}\sum_{i=1}^{n}\ln\left(\frac{1+\bar{g}/\bar{y}}{1+g_i/y_i}\right) = \frac{1}{n}\sum_{i=1}^{n}\ln\left(\frac{1+\bar{g}/\bar{y}}{1+g_i^c/y_i}\right) + \frac{1}{n}\sum_{i=1}^{n}\ln\left(\frac{1+g_i^c/y_i}{1+g_i/y_i}\right) \quad (6)$$

vertical component + horizontal component

The vertical component is the contribution to the change in total inequality (I^*- I) of the way in which mean impacts vary with pre-reform welfare levels. If there is no difference in the proportionate impact by level of welfare ($g_i^c / y_i = \bar{g}/\bar{y}$ for all i) then the vertical component is zero. The horizontal component is the contribution of the deviations in impacts from their conditional means. If the impact of the reform is predicted perfectly by pre-reform welfare ($g_i = g_i^c$ for all i) then the horizontal component is zero.

We also want to try and explain the differences in impacts in terms of observable characteristics of potential relevance to social protection policies. The way we have formulated the problem of measuring welfare impacts above allows utility and profit functions to vary between households at given prices. To try to explain the heterogeneity in measured welfare impacts we can suppose instead that these functions vary with observed household characteristics. The indirect utility function becomes:

$$v_i(p_i^s, p_i^d, w_i) = v(p_i^s, p_i^d, w_i, x_{1i}, x_{2i}) = \max[u(q_i^d, L_i, x_{1i}) \,|\, p_i^d q_i^d - w_i L_i = \pi_i] \quad (7)$$

where $\pi_i = \pi(p_i^s, x_{2i}) = \max[p_i^s q_i^s - c(q_i^s, x_{2i})]$. Note that we allow the characteristics that influence preferences over consumption (x_{1i}) to differ from those that influence the profits from own-production activities (x_{2i}).

The gain from the price changes induced by trade reform, as given by equation (7), depends on the consumption, labor supply and production choices of the household, which depend in turn on prices and characteristics, x_{1i} and x_{2i}. For example, households with a higher proportion of children will naturally spend more on food, so if the relative price of food changes

then the welfare impacts will be correlated with this aspect of household demographics. Similarly, there may be differences in tastes associated with stage of the life cycle and education. There are also likely to be systematic covariates of the composition of welfare.

Generically, we can now write the gain as:

$$g_i = g(p_i^s, p_i^d, w_i, x_{1i}, x_{2i}) \tag{8}$$

However, we do not observe the household-specific wages and prices. So we must make further assumptions. In explaining the variation across households in the predicted gains from trade reform we assume that: (i) the wage rates are a function of prices and characteristics as $w_i = w(p_i^d, p_i^s, x_{1i}, x_{2i})$ and (ii) differences in prices faced can be adequately captured by a complete set of regional dummy variables.

Under these assumptions, and linearizing (8) with an additive innovation error term, we can write down the following regression model for the gains:

$$g_i = \beta_1 x_{1i} + \beta_2 x_{2i} + \sum_k \gamma_k D_{ki} + \varepsilon_i \tag{9}$$

where $D_{ki} = 1$ if household *i* lives in county *k* and $D_{ki} = 0$ otherwise and ε_i is the error term.

3. Measured welfare impacts of trade reform in Morocco

3.1 The predicted price changes and the survey data

The price changes (implied by trade reform) we use here were generated by a CGE model that was commissioned by a joint working group of the Ministry of Agriculture, Government of Morocco, and the World Bank, as documented in Doukkali (2003). The model was constructed with the aim of realistically representing the functioning of the Moroccan economy around 1997-98. The model was explicitly designed to assess the aggregate impacts of de-protecting cereals in Morocco. In addition to allowing for interactions between agriculture and the rest of the

economy (represented by six sectors), the model is quite detailed in its representation of the agricultural sector. It allows for 16 different crops or groups of crops, three different livestock activities, 13 major agro-industrial activities, six agro-ecological regions, and within each region the model distinguishes between rainfed agriculture and four types of irrigated agriculture. The model has two types of labor, both with fixed real wage rates.

Four policy simulations are undertaken. The simulations then differ in the extent of the tariff reductions for cereals, namely 10% (Policy 1), 30% (Policy 2), 50% (Policy 3) and 100% (Policy 4). In all cases, the government's existing open-market operations, which attempt to keep down consumer prices by selling subsidized cereals, are also removed.[8] The loss of revenue from a 50% tariff cut approximately equals the saving on subsidies.

Table 1 gives the predicted prices changes for various trade liberalization scenarios, based on Doukkali (2003).[9] As one would expect, the largest price impact is for cereals, though there are some non-negligible spillovers into other markets, reflecting substitutions in consumption and production and welfare effects on demand. Some of these spillover effects are compensatory. For example, some producer prices rise with the de-protection of cereals.

The survey data set used here is the Enquête National sur le Niveau de Vie Ménages (ENNVM) for 1998 done by the government's Department of Statistics, which kindly provided the data set for the purpose of this study. This is a comprehensive multi-purpose survey

[8] In addition to administering the tariffs on imported soft wheat, the Government of Morocco buys, mills and sells around one million tons of soft wheat in the form of low grade flour, which is sold on the open market to help consumers.

[9] Rachid Doukkali kindly provided price predictions from the CGE model mapped into the categories of consumption and production identified in the survey. The production revenues were calculated from the survey data by matching these consumption categories to the variables containing information about household production of the corresponding goods.

following the practices of the World Bank's Living Standards Measurement Study.[10] The ENNVM has a sample of 5,117 households (of which 2,154 are rural) spanning 14 of Morocco's 16 regions (the low density southernmost region — the former Spanish Sahara — was excluded). The sample is clustered and stratified by region and urban/rural areas. The survey did not include households without a fixed residence ("sans abris"). The survey allows calculation of a comprehensive consumption aggregate (including imputed values for consumption from own production). We used the consumption numbers calculated by the Department of Statistics. This is our money metric of welfare. Ideally this would be deflated by a geographic cost-of-living index, but no such index was available, given the aforementioned lack of geographic price data.

3.2 Implied welfare impacts at household level

Tables 2a,b give the budget and income shares at mean points and the mean welfare impacts broken down by commodity based on the ENNVM; Table 2a is for consumption while 2b is for production. Notice how different consumption patterns are between urban and rural areas; for example, rural households have twice the budget share for cereals as urban households. Strikingly, while there is a 1.7% gain to urban consumers as a whole, this is largely offset by the general equilibrium effects through other price changes (Table 2a). Also notice that income obtained directly from production accounts for about one-quarter of consumption; the rest is labor earnings, transfers and savings. Of course in rural areas, the share is considerably higher, at 87%. And about one-third of this is from cereals.[11]

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[10] The survey's design and content are similar in most respects to the 1991 Living Standards Survey for Morocco documented in the LSMS web site: http://www.worldbank.org/lsms/ .

[11] Notice that there is no income from meat recorded in the data. The most plausible explanation is that Moroccan farmers sell livestock to butchers or abattoirs rather than selling meat as such. Following conventional survey processing practices, livestock is treated as an asset, so that proceeds from the selling of livestock is not treated as income. This is questionable. As a test, we redid our main calculations using the survey data on the transaction in livestock, and adding net sales into income. This made negligible difference to the results. Details are available from the authors.

Table 3 summarizes the results on the implied welfare impacts. Our results indicate that the partial trade reforms have only a small positive impact on the national poverty rate, as given by the percentage of the population living below the official poverty lines for urban and rural areas used by the Government's statistics office.[12] However, a larger impact emerges when we simulate complete de-protection (Policy 4). Then the national poverty rate rises from 20% to 22%. All four reforms entail a decrease in urban poverty (though less than 0.4% points) and an increase in rural poverty. (We will examine impacts over the whole distribution below.)

Turning to the impacts on inequality in Table 3, we find that the trade reforms yield a small increase in inequality, with the Gini index rising from 0.385 in the base case to 0.395 with a complete de-protection of cereals (Policy 4). Impacts are smaller for the partial reforms (Policies 1-3). The overall per capita gain is positive for the smaller tariff reduction (Policy 1) but becomes negative for Policies 2, 3 and 4. As one would expect, there is a net gain to consumers and net loss to producers, though the amounts involved are small overall. There are small net gains in the urban sector for Policies 1-3. Larger impacts are found in rural areas, as we would expect. The mean percentage loss from complete de-protection is a (non-negligible) 5.7% in rural areas.

Table 3 gave our results for the impact on poverty as estimated using the government's official poverty lines. It is important to test robustness to alternative poverty lines. For this purpose, we use the "poverty incidence curve," which is simply the cumulative distribution function up to a reasonable maximum poverty line. The results are given in Figure 1; to make the figure easier to read we focus on Policies 1 and 4. (The curves for Policies 2 and 3 are between these two.)

[12] These have been updated using the CPI. The poverty lines were 3922 Dirham per year in urban areas and 3037 in rural areas. See World Bank (2001) for details.

We see that there is an increase in poverty overall from complete de-protection; this is robust to the poverty line and poverty measure used (within a broad class of measures; see Atkinson, 1987). The impact on poverty is almost entirely in rural areas; indeed, there is virtually no impact on urban poverty. However, in rural areas the results in Figure 1 suggest a sizeable impact on poverty from complete de-protection. The mean loss as a proportion of consumption for the poorest 15% in rural areas is about 10%. There is an increase in the proportion of the rural population living below 2000 Dirham per person per year from 6.2% to 9.9%; the proportion living below 3000 Dirham rises from 22.2% to 26.3%. (For the country as a whole, the poverty rate for the former poverty line rises from 2.8% to 4.4% under Policy 4, while it rises from 11.4% to 13.1% for the 3000 Dirham line.)

Our finding of adverse impacts on the rural poor contradicts claims made by some observers who have argued that the rural poor tend to be net consumers of cereals, the commodity that incurs the largest price decrease with this trade reform (Table 1). We will return to this point when we study the welfare impacts further.

Table 4 gives the mean impacts of Policy 4 by region, split urban and rural. Impacts in urban areas are small in all regions, with the highest net gain as a percentage of consumption being 1.3% in Tanger-Tetouan, closely followed by Tensift Al Haouz and Fes-Boulemane. The rural areas with largest mean losses from de-protection of cereals are Tasla Azilal, Meknes Tafil, Fes-Boulemane and Tanger-Tetouan. Table 4 also gives mean impacts for the poorest 15% in rural areas (in terms of consumption per person). When we focus on the rural poor defined this way, the region incurring the largest mean loss for rural households is Tanger-Tetouan, followed by Fes-Boulemane and Chaouia-Ouardigha. The contrast between the small net gains to the urban sector and net losses to the rural poor is most marked in Tanger-Tetouan.

To begin exploring the heterogeneity in welfare impacts, Figure 2 gives the cumulative frequency distributions of the gains and losses. To simplify the figure we again focus on Policies 1 and 4. We find that with complete de-protection (Policy 4) about 8.9% of the households incurred losses greater than 500 Dirhams per year (about 5% of overall mean consumption) while about 5% lose more than 1000 Dirhams per year. As one would expect, there is a "thicker tail" of negative gains for rural areas. About 16% of rural households lose more that 500 Dirhams and 10% lose more than 1000.

In Figure 3 we plot the mean gains against percentiles of consumption per capita for Policies 1 and 4. We give both absolute gains/losses and gains as a percentage of the household's consumption. For policy 1, there is a tendency for the mean absolute gain to rise as one moves from the poorest percentile through to the richest, though the gradient is small. The mean proportionate gain is quite flat. For Policy 4, mean absolute impacts also rise up to the richest decile or so, but then fall. Proportionate gains follow the same pattern though (again) the gradient seems small.

However, what is most striking from Figure 3 is the wide spread, particularly downwards (indicating losers from the reform). The variance in absolute impacts is particularly large at the upper end of the consumption distribution, though if anything the dispersion in proprotionate impacts tends to be greater at the other end of the distribution, amongst the poorest.

In Figure 4 we provide a split between producers and consumers for Policy 4. As we would expect, to the extent that there is much impact on producers, they tend to lose, though not more so for poor producers than rich ones. For consumption we tend to see more gainers, and a higher variance in impact as one moves up the consumption distribution. However, we see that

the downward dispersion in total welfare impacts in Figure 3 is due more to the conditional variance in impacts through production than through consumption.

There are two quite striking findings in these figures. Firstly, notice that there are sizeable losses on the production side amongst the poor. Granted, some large losses are evident for the high-income groups. But the claims that the poor do not lose as producers are clearly false. Furthermore, the poor are often not seeing compensatory gains as consumers.

Secondly, it is notable that the results in Figures 3 and 4 indicate that the mean gains vary little with mean consumption. Focusing on the "poor" versus the "rich" is hardly of much interest in characterizing gainers and losers from this reform. The diversity in impacts tend to be "horizontal" in the distribution of income, meaning that there tend to be larger differences in impacts at given consumption than in mean impacts between different levels of consumption.

Next we examine these two findings in greater detail.

3.3 Who are the net producers of cereals in Morocco?

In the population as a whole, we find that 16% of households are net producers (value of cereals production exceeds consumption). These households are worse off from the fall in cereal prices due to de-protection. In rural areas, the proportion is 36%.

However, the survey data do not support the claim that the rural poor in Morocco are on average net consumers of cereals. Figure 5 shows how producers and net producers are spread across the distribution of total household consumption per person in rural Morocco. We give both the scatter of points and the conditional means estimated using the local regression method.[13] In the first (top left) panel we give the proportion of producers. Then we give the proportion of net producers (for whom production exceeds consumption of cereals in value

[13] See Cleveland (1979). This is often referred to as LOWESS (Locally Weighted Scatter Plot Smoothing). We used the LOWESS program in STATA.

terms). Finally we give net production in value terms. In each case the horizontal axis gives the percentile of the distribution of consumption from poorest through to richest.

We find that a majority of the rural poor produce cereals. Naturally much of this is for home consumption. However, even if we focus solely on net producers, we find that over one-third of the poorest quintile tend to produce more than they consume. Furthermore, the mean net production in value terms tends to be positive for the poor; in rural areas, the losses to poor producers from falling cereal prices outweigh the gains to poor consumers. More than any single feature of the survey data, it is this fact that lies at the heart of our finding that the rural poor lose from the reform.

3.4 Vertical versus horizontal impacts on inequality

To measure the relative importance of the vertical versus horizontal differences in impact, we can use the decomposition method outlined in section 2. This decomposition requires an estimate of the conditional mean $E(g|y)$, i.e., the regression function of g on y. We estimated this using the nonparametric local regression method of Cleveland (1979).

Table 5 gives the results of this decomposition for each policy reform. For the small partial reform under Policy 1, the vertical component dominates, accounting for 73% of the impact on inequality. However, as one moves to the larger reforms, the horizontal component becomes relatively large. Indeed, we find that 119.8% of the impact of Policy 4 on inequality is attributable to the horizontal component, while -19.8% is due to the vertical component. So we find that the vertical component was inequality reducing for Policy 4, even though overall inequality rose (Table 5).

There is clearly a high degree of horizontal inequality in measured impacts at given mean consumption. Some of this is undoubtedly measurement error, which may well become more

important for larger reforms. But some is attributable to observable covariates of consumption and production behavior, as discussed in section 2. In trying to explain this variance in welfare impacts, the characteristics we consider include region of residence, whether the household lives in an urban area, household size and demographic composition of the household, age and age-squared of the household head, education and dummy variables describing some key aspects of the occupation and principle sector of employment; Table 6 gives summary statistics on the variables to be used in the regressions. We recognize that there are endogeneity concerns about these variables, though we think those concerns are minor in this context, especially when weighed against the concerns about omitted variable bias in estimates that exclude these characteristics. Under the usual assumption that the error term is orthogonal to these regressors, we estimate equation (9) by ordinary least squares.

The results are given in Table 7. Recall that these are averages across the impacts of these characteristics on the consumption and production choices that determine the welfare impact of given price and wage changes. This makes interpretation difficult. We view these regressions as being mainly of descriptive interest, to help isolate covariates of potential relevance in thinking about compensatory policy responses.

Focusing first on the results for Policy 4, we find that larger losses from full de-protection of cereals are associated with families living in rural areas, that are relatively smaller (the turning point in the U-shaped relationship is at a household size of about one), have more wage earners, higher education, work in commerce, transport etc., and live in Chaouia-Ouardigha, Rabat, Tadla Azilal and Meknes Tafil. Recall that these effects stem from the way household characteristics influence net trading positions in terms of the commodities for which prices change. So, for example, it appears that larger families tend to consume more cereals, and so gain more from the

lower cereals prices. Results are similar for partial de-protection, though education becomes insignificant for Policy 1.

In Table 8 we give an urban-rural breakdown of the regressions for Policies 1 and 4. There are a couple of notable differences. (Again we focus on Policy 4 in the interests of brevity.) We find significant positive effects of having more children and teenagers on the gains from trade reform in rural areas, presumably because such families are more likely to be cereal consumers. The education effect at higher levels of schooling is much more pronounced in urban areas. The effect of working in the transport and commerce sector is more statistically significant in urban areas, though this effect is still sizeable in rural areas. The regional effects are more statistically significant in urban areas than in rural areas. Of course there are still sizable regional differences in mean impacts in Table 8, though they are statistically less significant than we found in Table 7. In fact the quantitative magnitudes of the regional differences are just as large for rural areas in Table 8 as for urban plus rural areas in Table 7.

It should not be forgotten that the results in Tables 7 and 8 are conditional geographic effects (conditional on the values taken by other covariates in the regressions). As we saw in Table 4, there are pronounced (unconditional) geographic differences in mean impacts in rural areas across different regions. Whether one draws policy lessons more from the conditional or unconditional effects depends on the type of policy one is using. If it is simply regional targeting, then of course the unconditional geographic effects in Table 4 will be more relevant. However, finer targeting by household characteristics, in combination with regional targeting, will call for the sorts of results presented in Tables 7 and 8.

The share of the variance in gains that is accountable to these covariates is generally less than 10%. Values of R^2 of this size are common in regressions run on large cross-sectional data

sets, though it remains true that a large share of the variance in impacts is not accountable to these covariates. (The exception to our low R^2 is for Policy 1, for which almost half of the variance in gains across urban households is explained.) It must be expected that there is a sizable degree of measurement error in the gains, stemming from measurement error in the underlying consumption and production data. No doubt there are also important idiosyncratic factors in household-specific tastes or production choices.

These regressions try to explain the variance in the gains from the reform. It is of interest to see if we can do any better in explaining the incidence of losses from reform amongst the poor. This is arguably of greater relevance to compensatory policies, which would presumably want to focus on poor losers. To test how well the same set of regressors could explain who was a poor loser from the reforms, we constructed a dummy variable taking the value unity if a rural household incurred a negative loss and was "poor"; to assure a sufficient number of observations taking the value unity we set the poverty line higher than the official line, namely at a consumption per person of 5,000 Dirham per year (rather than the official line of about 3,000). (We confined this to rural areas since that is where the losses are concentrated.) In the case of full de-protection (Policy 4), we find that about 14% of the variance in this measure can be explained by the set of regressors in Table 8, while for Policy 1 the share is 20%.[14] While there are a number of identifiable covariates for identifying likely losers amongst the poor, it is also clear that there is a large share of the variance left unexplained.

Another way to assess how effectively this set of covariates can explain the incidence of a net loss from reform amongst the poor is by comparing the actual value of the dummy variable described above with its predicted values from the model, using a cut-off probability of 0.5. For

[14] The R^2 for OLS regressions are 0.139 and 0.191 for Policy 4 and 1 respectively. Using instead a probit model to correct for the nonlinearity the pseudo R^2's are 0.135 and 0.196.

Policy 4, there are 472 households out of 2,100 who were both poor and incurred a loss due to the reform. Of these the model could only correctly predict that this was the case for 18% (86 households). For Policy 1, the model prediction was correct for 27% of the 463 households who were both poor and were made worse off by the reform.

Yet most forms of indicator targeting — whereby transfers are contingent on readily observed variables, such as location — would be based on similar variables to those we have used in our regressions; indeed, if anything targeted policies use fewer dimensions. This suggests that indicator targeting will be of only limited effectiveness in reaching those in greatest need. Self-targeting mechanisms that create incentives for people to correctly reveal their status (such as using work requirements) may be better able to do so.

3.5 Two caveats

While the above results are suggestive, two limitations of our analysis should be noted. The first stems from the fact that the Doukkali (2003) model assumed fixed wage rates. While sensitivity to alternative labor market assumptions should be checked, we can speculate on the likely impacts of allowing real wages to adjust to the reforms. Here it can be argued that the export-oriented cash crops that will replace cereals will tend to be more labor intensive than cereals. Thus we would expect higher aggregate demand for the relatively unskilled labor used in agriculture, and hence higher real wages for relatively poorer groups. This will undoubtedly go some way toward compensating the rural poor, and may even tilt the vertical distributional impacts in favor of the poor.

A second concern is that there may well be dynamic gains from greater trade openness that are not being captured by the model used to generate the relative price impacts; for example, trade may well facilitate learning about new agricultural technologies and innovation that brings

longer-term gains in farm productivity. These effects may be revealed better by studying time series evidence, combined with cross-country comparisons.

4. Conclusions

The welfare impacts of de-protection in developing countries have been much debated. Some people have argued that external trade liberalizations are beneficial to the poor, while others argue that the benefits will be captured more by the non-poor. Expected impacts on domestic prices have figured prominently in these debates.

The paper has studied the welfare impacts at household level of the changes in commodity prices attributed to a proposed trade reform, namely Morocco's de-protection of its cereals sector. This would entail a sharp reduction in tariffs, with implications for the domestic structure of prices and hence household welfare. The paper draws out the implications for household welfare of the previous estimates of the price impacts of reform done for a Joint Government of Morocco and World Bank Committee. Standard methods of first-order welfare analysis are used to measure the gains and losses at household level using a large sample survey.

In a number of respects, our detailed household-level analysis throws into question past claims about the likely welfare impacts of this trade reform. In the aggregate, we find a small negative impact on mean household consumption and a small increase in inequality. There is a sizable, and at least partly explicable, variance in impacts across households. Rural families tend to lose; urban households tend to gain. There are larger impacts in some provinces than others, with the greatest negative impacts for rural households in Tasla Azilal, Meknes Tafil, Fes-Boulemane and Tanger-Tetouan. Mean impacts for rural households in these regions are 10% or more of consumption. There are clearly sizeable welfare losses amongst the poor in these specific regions.

The adverse impact on rural poverty stems in large part from the fact that the losses to the net producers of cereals outweigh the gains to the net consumers amongst the poor. Thus, on balance rural poverty rises. This contradicts the generalizations that have been made in the past that the rural poor in Morocco tend to be net consumers of grain, and hence gainers from trade reform. Yes, a majority are net consumers, but on balance the welfare impacts on the rural poor are negative.

Our results lead us to question the high level of aggregation common in past claims about welfare impacts of trade reform. We find diverse impacts at given pre-reform consumption levels. This "horizontal" dispersion becomes more marked as the extent of reform (measured by the size of the tariff cut) increases. Indeed, we estimate that all of the impact of complete de-protection of cereals on inequality is horizontal rather than vertical; the vertical impact on inequality was actually inequality reducing. For a modest reform of a 10% cut in tariffs, the vertical component dominates, though there is still a large horizontal component. It is clear from our results that in understanding the social impacts of this reform, one should not look solely at income poverty and income inequality as conventionally measured; rather one needs to look at impacts along "horizontal" dimensions, at given income.

We have been able to identify some specific types of households whose consumption and production behavior makes them particularly vulnerable. These results are suggestive of the targeting priorities for compensatory programs. The fact that we also find a large share of unexplained variance in impacts also points to the limitations of targeting based on readily observable indicators, suggesting that self-targeting mechanisms may also be needed.

Table 1: Predicted price changes due to agricultural trade reform in Morocco

Sectors	Consumers (% change in prices)				Producers (% change in prices)			
	Policy 1	Policy 2	Policy 3	Policy 4	Policy 1	Policy 2	Policy 3	Policy 4
Cereals and cereals products	-3.062	-7.786	-12.811	-26.691	-2.858	-7.193	-11.744	-24.107
Fresh vegetables	-0.714	-0.884	-1.051	-1.128	-0.580	-0.767	-0.871	-0.756
Fruits	-0.637	-0.681	-0.683	-0.139	-0.429	-0.301	-0.104	0.843
Dairy products and eggs	-0.472	-0.414	-0.257	0.751	-0.505	-0.487	-0.333	0.637
Meat (red and poultry)	-0.320	-0.109	0.332	1.896	-0.306	-0.078	0.357	1.936
Sugar	-0.200	0.100	0.400	1.300	-0.368	-0.378	-0.354	-0.094
Edible oils	-0.671	-1.064	-1.405	-2.225	-0.632	-0.998	-1.336	-2.061
Fresh and processed fish	0.000	0.696	1.300	2.996	0.000	0.600	1.300	2.881
Other ag. and processed food	-0.369	-0.402	-0.421	-0.635	0.268	1.294	2.475	5.388
Services	0.142	0.500	0.758	1.460	0.056	0.500	0.844	1.708
Energy, electricity and water	-0.060	0.540	1.140	2.580	-0.051	0.549	1.149	2.597
Other industries	0.000	0.600	1.200	2.800	0.000	0.600	1.200	2.793

Note: The tariff cuts on imported cereals are 10%, 30%, 50% and 100% for Policies 1,2,3 and 4 respectively.

Table 2a: Consumption shares and welfare impacts through consumption

	Consumption Shares	Policy 1	Policy 2	Policy 2	Policy 4
National					
Cereals	*0.084*	0.2572	0.6540	1.0761	2.2420
Fresh vegetables	*0.042*	0.0297	0.0368	0.0437	0.0469
Fruits	*0.022*	0.0139	0.0148	0.0148	0.0030
Dairy products and eggs	*0.032*	0.0153	0.0134	0.0083	-0.0243
Meat (red and poultry)	*0.112*	0.0359	0.0122	-0.0373	-0.2129
Sugar	*0.015*	0.0030	-0.0015	-0.0060	-0.0195
Edible oils	*0.032*	0.0212	0.0336	0.0444	0.0703
Fresh and processed fish	*0.013*	0.0000	-0.0089	-0.0166	-0.0383
Ag. and processed food	*0.101*	0.0371	0.0405	0.0424	0.0640
Services	*0.066*	-0.0094	-0.0332	-0.0504	-0.0971
Energy, electricity, water	*0.148*	0.0089	-0.0799	-0.1688	-0.3819
Other industries	*0.333*	0.0000	-0.2000	-0.4001	-0.9335
Total	***1.000***	***0.4127***	***0.4817***	***0.5506***	***0.7187***
Urban					
Cereals	0.066	0.2034	0.5172	0.8510	1.7730
Fresh vegetables	0.037	0.0264	0.0327	0.0389	0.0417
Fruits	0.022	0.0139	0.0149	0.0149	0.0030
Dairy products and eggs	0.034	0.0160	0.0141	0.0087	-0.0255
Meat (red and poultry)	0.107	0.0342	0.0116	-0.0355	-0.2027
Sugar	0.011	0.0021	-0.0011	-0.0042	-0.0138
Edible oils	0.024	0.0163	0.0258	0.0341	0.0540
Fresh and processed fish	0.014	0.0000	-0.0096	-0.0180	-0.0414
Ag. and processed food	0.096	0.0354	0.0386	0.0404	0.0610
Services	0.067	-0.0095	-0.0333	-0.0505	-0.0973
Energy, electricity, water	0.155	0.0093	-0.0835	-0.1763	-0.3990
Other industries	0.368	0.0000	-0.2207	-0.4414	-1.0300
Total	***1.000***	***0.3476***	***0.3067***	***0.2621***	***0.1231***
Rural					
Cereals	0.136	0.4154	1.0565	1.7383	3.6217
Fresh vegetables	0.055	0.0394	0.0487	0.0579	0.0622
Fruits	0.021	0.0137	0.0146	0.0146	0.0030
Dairy products and eggs	0.028	0.0131	0.0114	0.0071	-0.0208
Meat (red and poultry)	0.128	0.0410	0.0139	-0.0425	-0.2427
Sugar	0.028	0.0056	-0.0028	-0.0112	-0.0364
Edible oils	0.053	0.0356	0.0564	0.0746	0.1181
Fresh and processed fish	0.010	0.0000	-0.0068	-0.0126	-0.0291
Ag. and processed food	0.115	0.0422	0.0461	0.0482	0.0728
Services	0.066	-0.0094	-0.0330	-0.0501	-0.0965
Energy, electricity, water	0.129	0.0077	-0.0694	-0.1466	-0.3317
Other industries	0.232	0.0000	-0.1392	-0.2785	-0.6498
Total	***1.000***	***0.6042***	***0.9964***	***1.3993***	***2.4708***

Table 2b: Percentage gains from each policy: Production component

	Production as a share of total consumption	Policy 1	Policy 2	Policy 2	Policy 4
National					
Cereals	*0.089*	-0.2713	-0.6899	-1.1352	-2.3652
Fresh vegetables	*0.053*	-0.0381	-0.0471	-0.0560	-0.0601
Fruits	*0.041*	-0.0261	-0.0279	-0.0280	-0.0057
Dairy products and eggs	*0.051*	-0.0243	-0.0213	-0.0132	0.0386
Meat (red and poultry)	*0.000*	0.0000	0.0000	0.0000	0.0000
Sugar	*0.000*	0.0000	0.0000	0.0000	0.0000
Edible oils	*0.025*	-0.0169	-0.0268	-0.0354	-0.0560
Fresh and processed fish	*0.000*	0.0000	0.0000	0.0000	0.0000
Ag. and processed food	*0.002*	-0.0008	-0.0008	-0.0009	-0.0013
Services	*0.000*	0.0000	0.0000	0.0000	0.0000
Energy, electricity, water	*0.000*	0.0000	0.0000	0.0000	0.0000
Other industries	*0.000*	0.0000	0.0000	0.0000	0.0000
Total	***0.262***	***-0.3774***	***-0.8139***	***-1.2687***	***-2.4498***
Urban					
Cereals	*0.010*	-0.0311	-0.0792	-0.1303	-0.2716
Fresh vegetables	*0.008*	-0.0058	-0.0072	-0.0086	-0.0092
Fruits	*0.016*	-0.0105	-0.0112	-0.0112	-0.0023
Dairy products and eggs	*0.007*	-0.0031	-0.0027	-0.0017	0.0049
Meat (red and poultry)	*0.000*	0.0000	0.0000	0.0000	0.0000
Sugar	*0.000*	0.0000	0.0000	0.0000	0.0000
Edible oils	*0.013*	-0.0087	-0.0138	-0.0183	-0.0289
Fresh and processed fish	*0.000*	0.0000	0.0000	0.0000	0.0000
Ag. and processed food	*0.000*	0.0000	0.0000	0.0000	0.0000
Services	*0.000*	0.0000	0.0000	0.0000	0.0000
Energy, electricity, water	*0.000*	0.0000	0.0000	0.0000	0.0000
Other industries	*0.000*	0.0000	0.0000	0.0000	0.0000
Total	***0.054***	***-0.0593***	***-0.1142***	***-0.1701***	***-0.3071***
Rural					
Cereals	*0.319*	-0.9777	-2.4863	-4.0910	-8.5235
Fresh vegetables	*0.186*	-0.1329	-0.1645	-0.1955	-0.2099
Fruits	*0.113*	-0.0722	-0.0771	-0.0773	-0.0158
Dairy products and eggs	*0.183*	-0.0865	-0.0758	-0.0471	0.1375
Meat (red and poultry)	*0.000*	0.0000	0.0000	0.0000	0.0000
Sugar	*0.000*	0.0000	0.0000	0.0000	0.0000
Edible oils	*0.061*	-0.0409	-0.0649	-0.0857	-0.1357
Fresh and processed fish	*0.000*	0.0000	0.0000	0.0000	0.0000
Ag. and processed food	*0.008*	-0.0031	-0.0033	-0.0035	-0.0053
Services	*0.000*	0.0000	0.0000	0.0000	0.0000
Energy, electricity, water	*0.000*	0.0000	0.0000	0.0000	0.0000
Other industries	*0.000*	0.0000	0.0000	0.0000	0.0000
Total	***0.870***	***-1.3131***	***-2.8719***	***-4.5000***	***-8.7527***

Table 3: Household impacts of four trade reforms

	Baseline	Policy 1	Policy 2	Policy 3	Policy 4
National					
Poverty rate (%)	19.61	20.01	20.33	21.04	22.13
Mean Log Deviation (x100)	28.50	28.92	29.00	29.14	29.17
Gini index	0.385	0.387	0.389	0.391	0.395
Per capita gain	0	6.519	-23.967	-54.816	-133.81
Mean % gain: price changes weighted by mean shares	0	-0.059	-0.513	-0.971	-2.141
Mean % gain: weighted by ratios of means (Tables 2a,b)	0	0.035	-0.332	-0.718	-1.731
Production gain	0	-32.078	-69.012	-106.308	-201.017
Consumption gain	0	38.598	45.046	51.492	67.207
Consumption per capita	9350.913	9357.433	9326.947	9296.097	9217.104
Urban					
Poverty rate (%)	12.19	12.05	11.96	12.05	11.76
Mean Log Deviation (x100)	25.49	25.41	25.32	25.23	24.93
Gini index	0.366	0.365	0.365	0.364	0.362
Per capita gain	0	35.518	24.8	13.747	-16.491
Mean % gain: price changes weighted by mean shares	0	0.357	0.374	0.394	0.442
Mean % gain: weighted by ratios of means (Tables 2a,b)	0	0.288	0.193	0.092	-0.184
Production gain	0	-6.308	-12.103	-17.793	-31.302
Consumption gain	0	41.826	36.903	31.54	14.811
Consumption per capita	12031.2	12066.72	12056	12044.95	12014.71
Rural					
Poverty rate (%)	28.28	29.31	30.10	31.54	34.25
Mean Log Deviation (x100)	17.47	17.82	17.82	17.93	17.76
Gini index	0.312	0.313	0.315	0.318	0.328
Per capita gain	0	-33.532	-91.321	-149.512	-295.845
Mean % gain: price changes weighted by mean shares	0	-0.634	-1.737	-2.855	-5.708
Mean % gain: weighted by ratios of means (Tables 2a,b)	0	-0.709	-1.875	-3.101	-6.282
Production gain	0	-67.671	-147.612	-228.562	-435.419
Consumption gain	0	34.139	56.291	79.049	139.574
Consumption per capita	5649.034	5615.502	5557.712	5499.522	5353.189

Note: All monetary units are Moroccan Dirham per year. MLD is only calculated over the set of households for whom consumption is positive. The mean % gains weighted by mean shares are simply the means across the sample of the % gains at household level. The second mean % gain is weighted by shares at the means points based on Tables 2a,b.

Table 4: Mean gains from Policy 4 by region

Region	Total	Urban	Rural	Poorest 15% of rural households
Oued Ed-Dahab-Lagouira	-0.2	-0.2	.	.
Laayoune-Boujdour-Sakia El Hamra	-0.34	-0.34	.	.
Guelmime Es-Semara	-0.96	0.72	-3.47	-0.58
Souss-Massa-Daraa	-1.31	0.42	-2.4	-3.09
Gharb-Chrarda-Beni Hssen	-2.16	0.02	-3.86	0.1
Chaouia-Ouardigha	-4.18	0.32	-8.31	-10.11
Tensift Al Haouz	-0.87	1.12	-2.17	0.31
Oriental	-0.87	0.38	-2.78	0.25
G.Casablanca	0.48	0.41	2.41	.
Rabat-Salé-Zemmour-Zaer	-0.59	0.33	-4.98	0.23
Doukala Abda	-3.13	0.76	-5.92	-3.93
Tadla Azilal	-6.93	-0.71	-11.04	-0.95
Meknes Tafil	-4.89	-0.19	-11.35	-8.48
Fes-Boulemane	-2.4	1.05	-11.52	-13.43
Taza-Al Hoceima-Taounate	-4.47	-0.32	-5.78	-8.39
Tanger-Tetouan	-2.94	1.31	-9.4	-22.03
Total	**-2.14**	**0.45**	**-5.71**	**-10.39**

Note: Means formed over the household level % gains (equivalent to weighting proportionate price changes by mean shares).

Table 5: Decomposition of the impact on inequality

	Policy 1	Policy 2	Policy 3	Policy 4
Vertical component	72.69	57.57	38.77	-19.77
Horizontal component	27.31	42.43	61.23	119.77
Total	100	100	100	100

Note: The decomposition is only implemented on the sample of households for whom both the baseline and post-reform consumption is positive.

Table 6: Summary statistics on explanatory variables in the regression analysis

	Mean	*Std. Dev*
Urban	0.580	*binary*
Log household size	1.645	*0.550*
Log household size 2	3.009	*1.621*
Female headed household	0.170	*binary*
If unemployed present	0.248	*binary*
Number of wage earners	5.912	*2.878*
Share of children 0-6	0.140	*0.162*
Share of children 7-17	0.221	*0.204*
Share of elderly 60+	0.120	*binary*
Characteristics of the head		
Age of the head	0.505	*0.143*
Age of the head 2	0.275	*0.155*
Illiterate head	0.582	*binary*
Incomplete primary school	0.100	*binary*
Primary school completed	0.164	*binary*
Low secondary school	0.058	*binary*
Upper secondary school	0.059	*binary*
University	0.036	*binary*
Industry		
Not-employed	0.240	*binary*
Industrie/B.T.P	0.004	*binary*
Commerce/Transp./Commun./Admin.	0.273	*binary*
Service Soci.	0.085	*binary*
Autres services	0.064	*binary*
Corps Exter.	0.125	*binary*
Chomeur	0.012	*binary*
Femme au foyeur/Eleve/Etudiant	0.037	*binary*
Jeune enfant	0.009	*binary*
Vielliard/Retraite/Rentiers	0.074	*binary*
Infirme/malade	0.068	*binary*
Autre inactifs	0.010	*binary*
Regions		
Oued Ed-Dahab-Lagouira	0.012	*binary*
Laayoune-Boujdour-Sakia El Hamra	0.014	*binary*
Guelmime Es-Semara	0.023	*binary*
Souss-Massa-Daraa	0.094	*binary*
Gharb-Chrarda-Beni Hssen	0.058	*binary*
Chaouia-Ouardigha	0.054	*binary*
Tensift Al Haouz	0.100	*binary*
Oriental	0.065	*binary*
G.Casablanca	0.124	*Binary*
Rabat-Salé-Zemmour-Zaer	0.081	*Binary*
Doukala Abda	0.067	*Binary*
Tadla Azilal	0.047	*Binary*

Meknes Tafil	0.072	*binary*
Fes-Boulemane	0.051	*binary*
Taza-Al Hoceima-Taounate	0.058	*binary*

Table 7: Regression of per capita gain/loss on selected household characteristics

	Policy 1		Policy 2		Policy 3		Policy 4	
	Coeff.	s.e.	Coeff.	*s.e.*	Coeff.	*s.e.*	Coeff.	*s.e.*
Urban	26.139***	*6.275*	44.850***	*12.948*	64.218**	*20.068*	113.714**	*39.213*
Log household size	-57.242**	*19.583*	-78.454*	*40.407*	-100.548	*62.626*	-157.373	*122.376*
Log household size 2	77.337***	*16.806*	167.523***	*34.678*	260.865***	*53.746*	508.026***	*105.023*
Female headed household	2.502	*7.431*	4.072	*15.333*	5.605	*23.765*	9.161	*46.438*
If unemployed present	10.018*	*5.909*	23.344*	*12.192*	36.428*	*18.896*	67.997*	*36.924*
Number of wage earners	-44.722***	*7.019*	-101.428***	*14.484*	-159.842***	*22.448*	-313.541***	*43.865*
Share of children 0-6	32.783*	*17.72*	89.774*	*36.564*	145.705*	*56.67*	277.637*	*110.736*
Share of children 7-17	25.070*	*14.155*	69.367*	*29.206*	113.738*	*45.266*	221.518*	*88.453*
Share of elderly 60+	-21.3	*15.584*	-23.551	*32.155*	-24.389	*49.837*	-24.334	*97.385*
Characteristics of the head								
Age of the head	-38.511	*108.759*	-151.473	*224.41*	-272.681	*347.809*	-624.596	*679.642*
Age of the head 2	44.097	*102.579*	142.598	*211.658*	246.231	*328.045*	543.07	*641.022*
Household is literate only	-8.871	*7.983*	-23.441	*16.472*	-38.257	*25.53*	-76.735	*49.888*
Incomplete primary education				Reference				
Primary school completed	-14.013*	*6.757*	-40.623**	*13.942*	-68.220**	*21.608*	-141.296***	*42.224*
Low secondary school	-12.98	*10.4*	-61.634**	*21.458*	-112.583***	*33.258*	-250.335***	*64.989*
Upper secondary school	-12.462	*10.775*	-70.619**	*22.233*	-130.320***	*34.458*	-286.333***	*67.333*
University	2.575	*13.527*	-95.376***	*27.912*	-197.887***	*43.26*	-476.077***	*84.533*
Industry								
Not-working/Agriculture				Reference				
Industrie/B.T.P	-3.71	36.465	-0.277	75.242	4.541	116.616	21.281	227.874
Commerce/Transport/ Communications/Admin.	-59.926***	8.198	-122.454***	16.915	-185.113***	26.216	-341.751***	51.228
Service Soci.	4.424	10.036	17.18	20.707	30.536	32.094	66.804	62.714
Autres services	-0.2	11.251	9.572	23.214	19.812	35.98	47.874	70.306
Corps Exter.	2.385	8.936	6.785	18.439	10.912	28.579	20.23	55.844
Chomeur	6.627	21.518	27.715	44.399	49.65	68.813	107.951	134.465
Femme au foyeur/Eleve/Etudiant	2.26	*13.49*	13.788	*27.835*	25.401	*43.141*	55.785	*84.301*
Jeune enfant	7.629	*24.5*	-3.891	*50.553*	-16.336	*78.352*	-51.207	*153.104*
Vielliard/Retraite/Rentiers	6.913	*11.039*	23.527	*22.778*	40.651	*35.303*	86.8	*68.984*
Infirme/malade	3.143	*10.96*	22.092	*22.614*	42.489	*35.049*	100.065	*68.488*
Autre inactifs	-9.955	*22.723*	1.817	*46.885*	15.364	*72.667*	56.497	*141.995*
Regions								
Oued Ed-Dahab-Lagouira	19.216	*22.51*	-6.738	*46.446*	-34.818	*71.986*	-111.388	*140.665*
Laayoune-Boujdour-Sakia El Hamra	-1.502	*21.067*	-20.145	*43.47*	-40.764	*67.374*	-98.323	*131.652*
Guelmime Es-Semara	9.666	*16.639*	11.901	*34.333*	12.774	*53.212*	12.391	*103.979*
Souss-Massa-Daraa	-7.645	*10.868*	5.611	*22.425*	22.766	*34.756*	85.2	*67.916*
Gharb-Chrarda-Beni Hssen	-10.087	*12.229*	-7.485	*25.232*	-3.592	*39.107*	10.494	*76.418*
Chaouia-Ouardigha	-19.542	*12.507*	-49.255*	*25.807*	-81.319*	*39.998*	-169.114*	*78.159*

Tensift Al Haouz	2.964	*10.696*	14.527	*22.071*	27.258	*34.207*	65.274	*66.842*
Oriental	-14.038	*11.928*	-19.198	*24.612*	-23.918	*38.145*	-31.056	*74.539*
G.Casablanca	-3.322	*10.429*	-15.762	*21.518*	-28.418	*33.35*	-60.086	*65.169*
Rabat-Salé-Zemmour-Zaer	-15.439	*11.326*	-33.817	*23.371*	-52.199	*36.222*	-97.061	*70.78*
Doukala Abda	-13.169	*11.76*	-23.668	*24.265*	-34.315	*37.607*	-59.462	*73.487*
Tadla Azilal	-55.774***	*13.093*	-114.700***	*27.016*	-174.099***	*41.872*	-320.810***	*81.821*
Meknes Tafil	-37.594**	*11.54*	-74.192**	*23.812*	-111.929**	*36.906*	-209.391**	*72.117*
Fes-Boulemane	-10.249	*12.726*	-15.356	*26.259*	-20.651	*40.699*	-33.326	*79.528*
Taza-Al Hoceima-Taounate	5.613	*12.367*	2.43	*25.517*	-2.415	*39.549*	-21.329	*77.281*
Tanger-Tetouan	Reference							
Constant	144.096***	34.638	247.104***	71.*472*	354.469**	*110*.773	642.381**	216.458
R^2	0.175		0.080		0.062		0.057	

Table 8: Urban-rural split of regressions for per capita gains

	Urban				Rural			
	Policy 1		Policy 4		Policy 1		Policy 4	
	Coeff.	*s.e.*	Coeff.	*s.e.*	Coeff.	*s.e.*	Coeff.	*s.e.*
Log household size	-32.840*	*16.071*	45.705	*83.159*	-89.255*	*45.084*	-527.017*	*294.353*
Log household size 2	40.492*	*17.841*	217.663*	*92.32*	79.415*	*32.524*	555.880**	*212.348*
Female headed household	-2.696	*6.018*	-15.603	*31.139*	11.984	*16.902*	27.785	*110.356*
If unemployed present	2.138	*4.668*	25.238	*24.154*	11.086	*14.482*	35.299	*94.551*
Number of wage earners	-23.972**	*8.39*	-143.745***	*43.414*	-45.101***	*12.237*	-321.182***	*79.894*
Share of children 0-6	-15.648	*15.206*	25.903	*78.686*	95.815**	*36.544*	609.370*	*238.601*
Share of children 7-17	-10.44	*11.986*	-34.073	*62.023*	81.378**	*29.771*	622.563**	*194.376*
Share of elderly 60+	-17.696	*13.328*	4.67	*68.967*	-35.448	*32.512*	-167.42	*212.274*
Characteristics of the head								
Age of the head	-26.02	*96.18*	-513.051	*497.696*	-82.081	*216.7*	-1.00E+03	*1414.846*
Age of the head 2	33.769	*91.377*	263.429	*472.842*	103.772	*202.766*	1129.226	*1323.868*
Household is literate only	-10.567	*6.965*	-90.700*	*36.042*	-8.718	*16.11*	-75.293	*105.182*
Incomplete primary education				*Reference*				
Primary school completed	0.157	*5.566*	-44.272	*28.804*	-31.613*	*14.794*	-270.881**	*96.589*
Low secondary school	6.416	*7.632*	-119.177**	*39.494*	-73.971*	*31.399*	-655.218**	*205.005*
Upper secondary school	-5.731	*7.551*	-249.358***	*39.074*	10.925	*49.861*	-46.655	*325.547*
University	9.241	*9.282*	-433.456***	*48.03*	20.185	*83.244*	18.883	*543.507*
Industry								
Not-working/Agriculture				*Reference*				
Industrie/B.T.P	-4.779	*25.641*	7.254	*132.684*	56.769	*124.939*	366.598	*815.737*
Commerce/Transp./Commun./ Admin.	-96.116***	*10.172*	-444.047***	*52.634*	-43.789**	*15.445*	-257.349*	*100.843*
Service Soci.	-1.428	*7.574*	6.102	*39.191*	27.61	*28.965*	247.156	*189.116*
Autres services	-4.7	*9.133*	6.023	*47.259*	21.228	*25.434*	161.257	*166.061*
Corps Exter.	-2.611	*6.884*	-19.401	*35.621*	8.742	*23.042*	57.723	*150.44*
Chomeur	-1.702	*15.213*	36.377	*78.72*	60.148	*73.543*	457.084	*480.167*
Femme au oyeur/Eleve/Etudiant	-4.019	*10.145*	12.554	*52.498*	20.295	*36.207*	110.127	*236.4*
Jeune enfant	-2.268	*16.343*	-129.322	*84.567*	107.247	*152.23*	720.704	*993.92*
Vielliard/Retraite/Rentiers	1.108	*8.138*	48.765	*42.112*	25.588	*34.261*	154.32	*223.691*
Infirme/malade	1.847	*8.176*	63.019	*42.308*	5.864	*30.489*	148.543	*199.063*
Autre inactifs	-12.094	*16.532*	23.685	*85.547*	22.652	*67.323*	250.306	*439.559*
Regions								
Oued Ed-Dahab-Lagouira	21.2	*15.068*	-135.288*	*77.973*				
Laayoune-Boujdour-Sakia El Hamra	-2.496	*14.153*	-129.348*	*73.236*				
Guelmime Es-Semara	7.558	*13.813*	-50.41	*71.475*	23.284	*35.563*	165.753	*232.195*
Souss-Massa-Daraa	-1.425	*10.023*	-54.723	*51.863*	-8.417	*21.371*	211.302	*139.535*
Gharb-Chrarda-Beni Hssen	-44.733***	*11.143*	-204.020***	*57.663*	17.31	*23.762*	208.808	*155.141*
Chaouia-Ouardigha	-15.625	*11.08*	-89.734	*57.333*	-19.527	*25.012*	-201.804	*163.304*
Tensift Al Haouz	-8.763	*9.759*	-37.2	*50.5*	8.732	*21.097*	147.015	*137.74*
Oriental	-18.776*	*9.806*	-96.129*	*50.74*	-0.357	*25.851*	99.206	*168.782*

G.Casablanca	-9.23	*7.849*	-112.350**	*40.617*	5.551	*49.268*	79.412	*321.673*
Rabat-Salé-Zemmour-Zaer	-13.825	*8.683*	-118.444**	*44.931*	-36.873	*30.677*	-142.714	*200.295*
Doukala Abda	-14.916	*10.867*	-80.126	*56.232*	-8.244	*22.773*	-3.679	*148.687*
Tadla Azilal	-50.624***	*12.423*	-213.855***	*64.285*	-51.570*	*24.832*	-324.785*	*162.13*
Meknes Tafil	-22.753*	*9.622*	-126.779*	*49.79*	-56.111*	*24.782*	-311.079*	*161.8*
Fes-Boulemane	-11.946	*9.954*	-38.193	*51.509*	-2.002	*30.661*	-5.31	*200.186*
Taza-Al Hoceima-Taounate	-20.264	*13.982*	-161.597*	*72.352*	16.747	*22.229*	80.917	*145.137*
Tanger-Tetouan				*Reference*				
Constant	135.395***	30.386	463.951**	*157.*234	162.613*	*72.*909	959.343*	476.029
R2	0.46		0.08		0.062		0.067	

Figure 1: Impacts on poverty

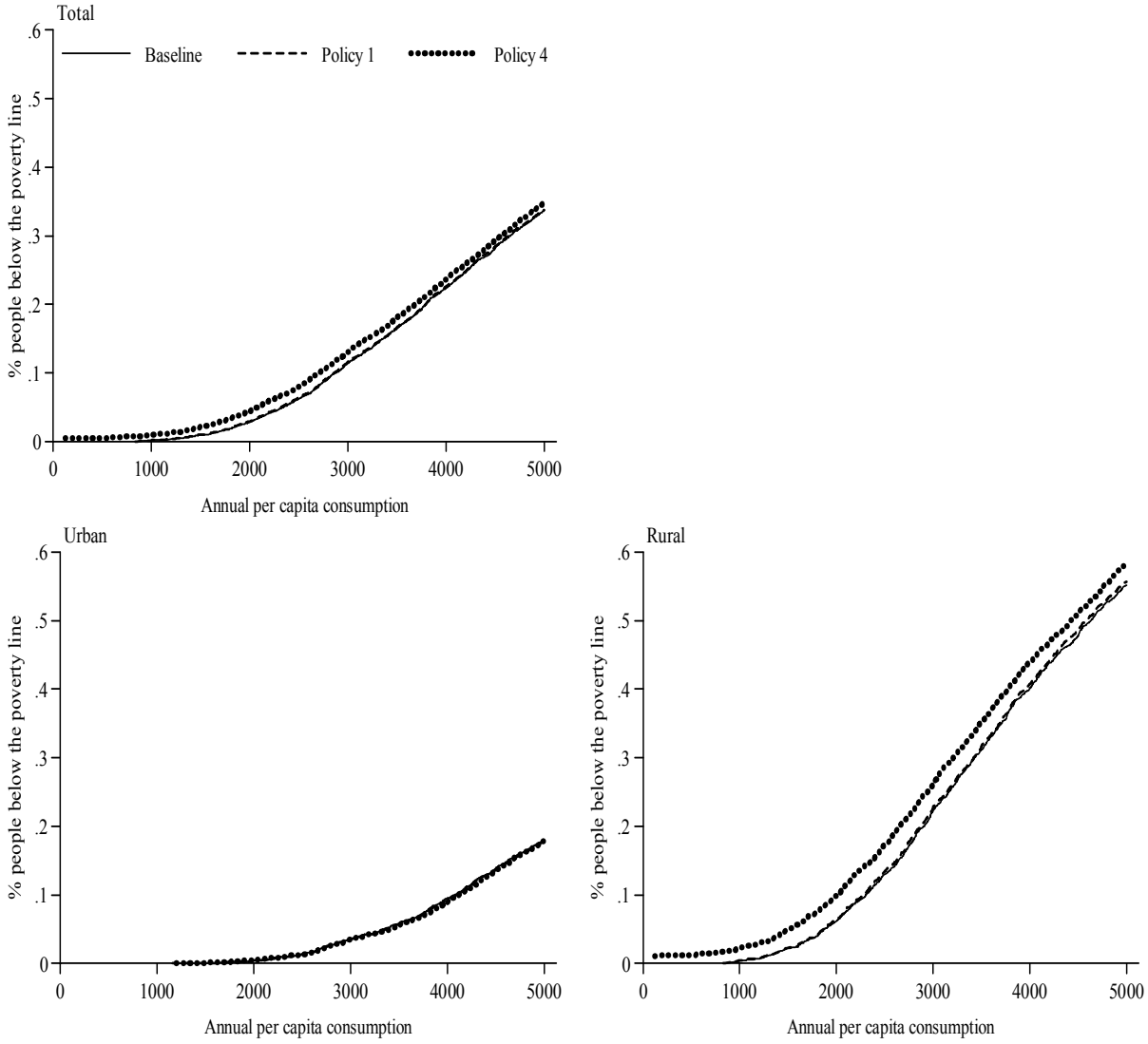


Figure 2: Frequency distributions of gains/losses for Policies 1 and 4

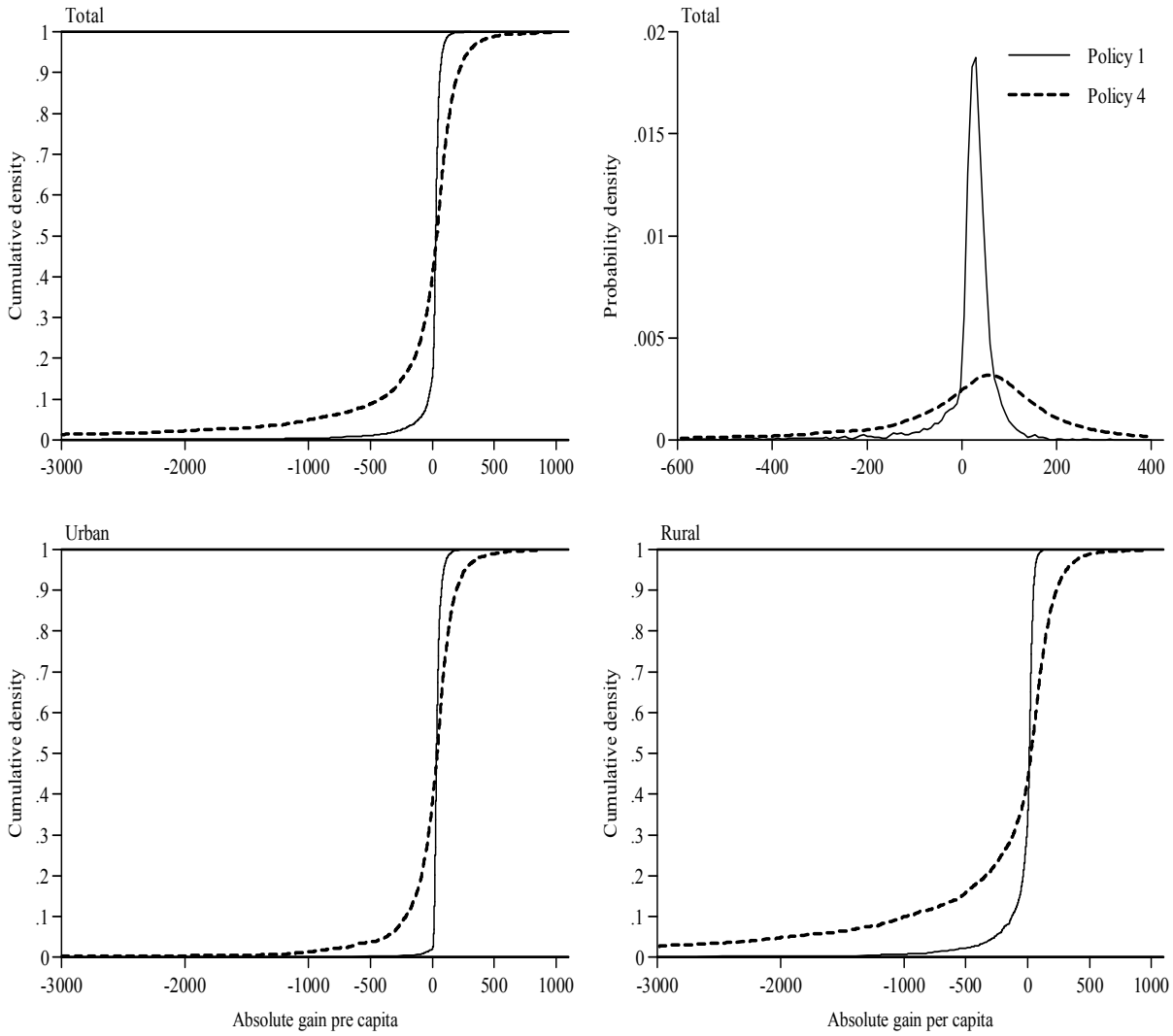


Figure 3: Absolute and proportionate gains for Policies 1 and 4 plotted against percentile of consumption

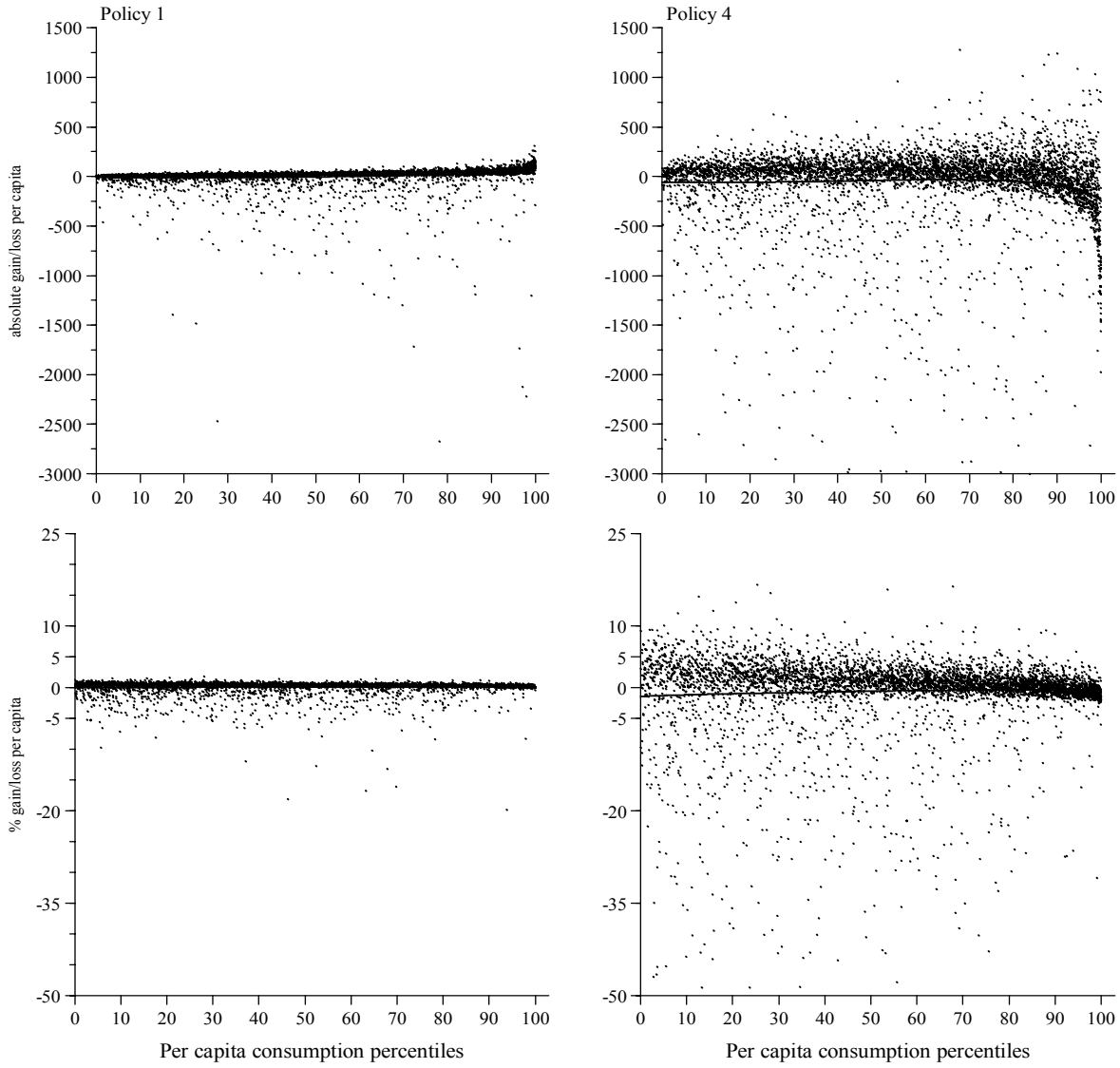


Figure 4: Production/consumption decomposition of the welfare impacts for Policy 4, plotted against percentile of consumption per person

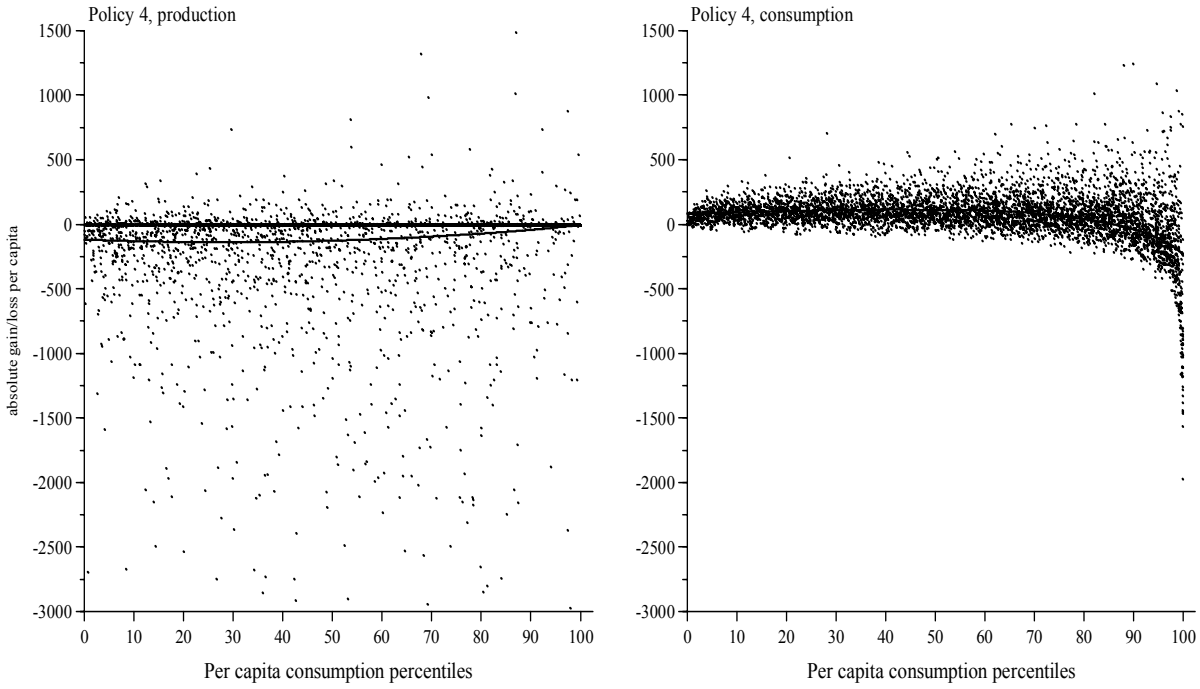
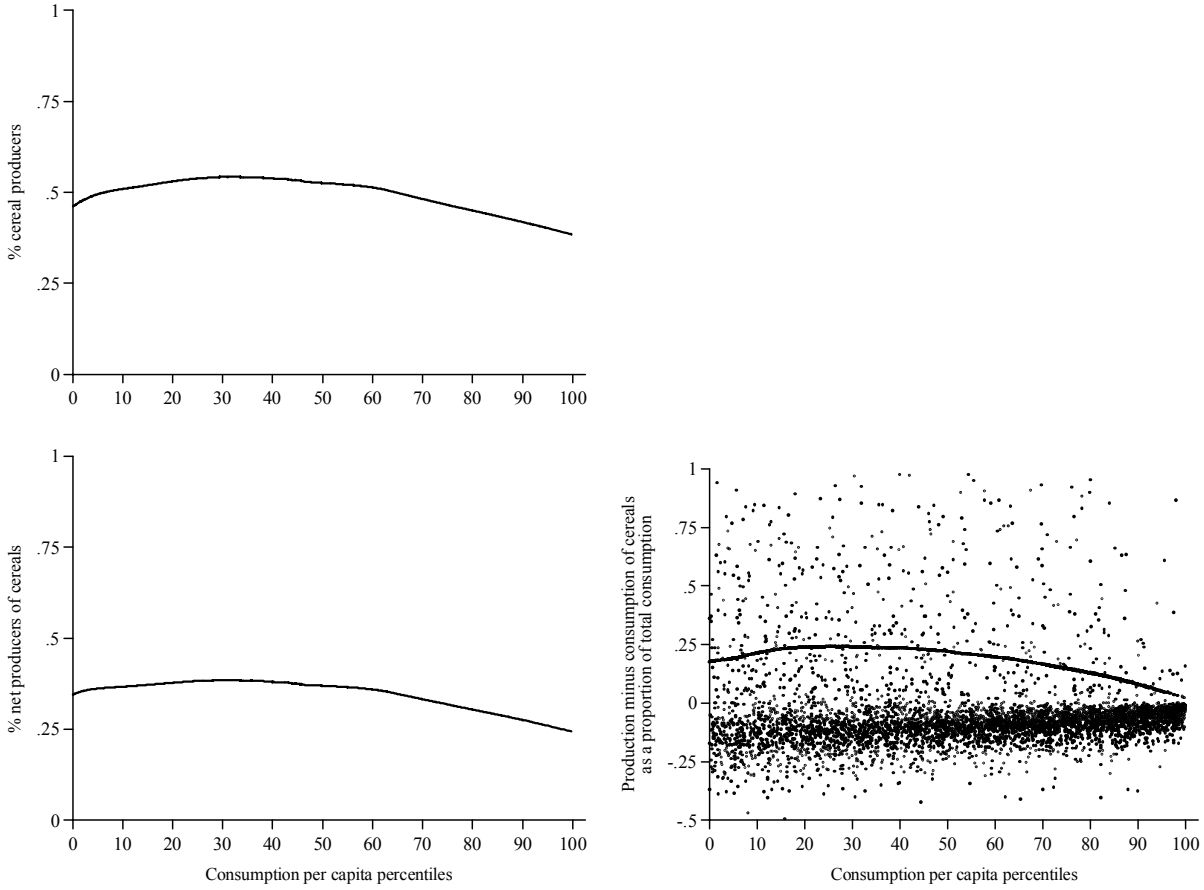


Figure 5: Net producers of cereals in the distribution of total consumption per person in rural areas



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