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Looking Beyond Averages in the Trade and Poverty Debate

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Abstract

There has been much debate about how much poor people in developing countries gain from trade openness, as one aspect of 'globalization'. The paper views the issue through both 'macro' and 'micro' empirical lenses. The macro lens uses cross-country comparisons and aggregate time series data; the micro lens uses household-level data combined with structural modelling of the impacts of specific trade reforms. Case studies are presented for China and Morocco. Both the macro and micro approaches cast doubt on some widely heard generalizations from both sides of the globalization debate. Additionally the micro lens indicates considerable heterogeneity in the welfare impacts of trade openness, with both gainers and losers among the poor. A number of covariates of the individual gains are identified. The results point to the importance of combining trade reforms with well-designed social protection policies.

Keywords: trade, globalization, poverty, inequality, China, Morocco

JEL classification: F14, O53, P36

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1 Introduction

Some observers have argued that poor people share amply in the gains from external trade liberalization in developing countries, while others argue that the benefits are captured by those who are not particularly poor. Various methods have been used to address the issue empirically, including cross-country comparisons, aggregate time series analyses at the country level, and various simulation methods using both partial and general equilibrium analyses.[1] A common feature of all these methods is that they attempt to measure the impact of trade openness (or policies to promote openness) on some aggregate measure of inequality or poverty.

This paper explores further the relationship between trade and poverty. A theme of the paper is the inadequacy of the conventional 'macro lens' on the trade-poverty relationship. We have learned from the (massive) expansion in household-level data availability for developing countries over the last 15 years that there is considerable heterogeneity among poor people in their net trading positions in most markets. Some of the poor are net consumers of food, for example, while some are net producers. This heterogeneity carries an important lesson for the debate on trade and poverty: conventional poverty and inequality aggregates may hide much more than they reveal.

The following section reviews evidence from cross-country comparisons, while section 3 examines the same issues using aggregate time series data for China. Sections 4 and 5 turn to two case studies using the 'micro lens' of household level data, in combination with a general equilibrium analysis of the impacts of trade reform; section 4 studies trade reform in China while section 5 uses essentially the same methods for Morocco. Section 6 concludes.

2 Macro lens 1: Cross-country comparisons

The extensive literature using cross-country comparisons has left ambiguous implications for the impact of trade openness on poverty within countries. A number of studies have combined survey-based measures of income inequality at country-level with data on trade and other control variables to assess the distributional impacts of trade openness; the latter is typically measured by 'trade volume', defined by exports plus imports as a share of GDP.[2] An influential study by Dollar and Kraay (2002, 2004) finds little or no effect of trade openness on inequality. Other studies have reported adverse effects on inequality. Lundberg and Squire (2003) find evidence that trade openness tends to increase inequality. Some studies also find evidence that higher trade

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1 The various methods used in the literature and the results of past studies are discussed in the useful surveys by McCulloch, Winters and Cirera (2001), Hertel and Reimer (2004) and Winters, McCulloch and McKay (2004).

2 Examples include Bourguignon and Morisson (1990), Edwards (1997), Li, Squire and Zou (1998), Barro (2000), Dollar and Kraay (2002, 2004), Lundberg and Squire (2003), and Milanovic (2004). No attempt is made to comprehensively review the literature; for that see Winters, McCulloch and McKay (2004).

volume is inequality increasing in poor countries but that the reverse holds at higher mean income (Ravallion 2001; Milanovic 2004).

Of course, the implications for poverty will also depend on the growth impacts of openness. Empirical support for the view that trade openness promotes economic growth can be found in (amongst others) Dollar (1992), Sachs and Warner (1995), Harrison (1996) and Edwards (1998). In a meta-study of all the cross-country growth regressions with an average of seven regressors (chosen from 67 candidates drawn from the literature on cross-country growth regressions) Sala-I-Martin, Doppelhofer and Miller (2004) report that trade volume is a significant in two-thirds of the regressions, though is not amongst their subset of 18 robust predictors of economic growth.

Whether the growth effects are strong enough such that poverty falls with trade openness remains unclear. The findings of Dollar and Kraay (2004) and others that trade does not affect inequality but fosters growth make it very likely that it lowers absolute poverty (meaning that the poverty line is fixed in real terms).[3] However, if (as some studies have claimed) the growth gains are captured more by the non-poor then this will attenuate the impacts on poverty.

There are continuing concerns about the data and econometric specifications in this literature. Results have differed across data sets and regression specifications, with little effort into reconciling the results. There are numerous differences in the control variables and differences in the assumptions made about the error term. On the latter, some studies have allowed for country-level fixed effects (such as Dollar and Kraay 2002) while others have not (such as Milanovic 2004). Allowing for country effects has the attraction that the results are then robust to the latent heterogeneity in (time-invariant additive) country characteristics, but it can also make it harder to detect the true relationship of interest when there is noise in the data. Differences in survey design and processing between countries and over time can add considerable (time-varying) noise to the measures of poverty and inequality.

There is also the issue of whether trade volume can be treated as exogenous in these cross-country regressions. Higher trade volume may be a response to growth rather than a cause. The policy implications are unclear since trade volume is not a policy variable; see the discussion in Rodriguez and Rodrik (2001). The attribution of either growth or inequality impacts to trade policy reforms is clearly problematic.

This paper makes no attempt to resolve these issues. However, it is of descriptive interest to at least see what the available data suggests about the relationship between trade openness and poverty. A convincing analysis of the relationship between the *levels* of poverty and trade openness would clearly requite a large number of control variables to account for country heterogeneity and even then there will no doubt be concerns about unobserved heterogeneity. Instead, the following analysis will bundle all time-invariant country characteristics into an additive error component and then examine the relationship between the changes over time in poverty and changes in trade

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3 This is intuitive, but strictly a conventional inequality index can be unchanged and yet growth in the mean does not reduce a standard measure of absolute poverty. In practice this appears to be rare.

openness, robustly to all latent heterogeneity due to time-invariant additive effects on poverty. The obvious place to start is the most common single measure of poverty and the most widely used measure of trade openness. The poverty measure is the percentage of people living below US$1.08 at 1993 Purchasing Power Parity and the trade measure is the sum of exports plus imports as a share of GDP.[4]

Figure 1 plots the proportionate changes in the poverty measure (difference in logs between two surveys) against the proportionate change in trade volume matched as closely as possible to the survey dates. The data used in the top panel of Figure 1 are for 178 'spells' defined by two surveys with more than one observation for most countries; there are 75 countries represented. The lower figure gives the results for the longest spell for each country.

There is no sign of any relationship in the top panel of Figure 1. The simple correlation coefficient across the 178 spells is 0.09. This does not change much if one allows for lagged effects of trade openness by regressing the change in poverty on both the current and lagged changes in trade volume; the multiple correlation coefficient is 0.13 (R^2 = 0.02). Nor does the result change if one adds controls for the initial poverty measure, initial mean income (private consumption per capita from national accounts), initial inequality (the Gini index), and the interactions between the latter two variables and the change in trade volume.[5] Again the parameters related to trade expansion were individually and jointly insignificant.

There is clearly a lot of noise in the short-term spells. Arguably the lower panel of Figure 1 using the 75 country-specific longest spells is more reliable, and it is arguably closer to the tests found in the literature using cross-country comparisons. Then a negative correlation emerges, with a correlation coefficient of –0.20. The regression coefficient of the change in log headcount index on the change in log trade volume is –0.84, which is significantly different from zero at the 3 per cent level (t= –2.18).[6] This is driven entirely by a correlation between growth rates in the survey mean and growth in the trade share; controlling for the change in the (log) survey mean the correlation vanishes (t= –0.80).

However, the correlation found in these 'long spells' appears to be rather fragile. Just adding controls for initial conditions makes the correlation vanish. For example, if one controls for the initial level of poverty then the regression coefficient of the change in log headcount index on the change in log trade volume drops to –0.41, and is not significantly different from zero (t= –1.05). Adding the further control variables mentioned above does not make the relationship any stronger. It remains clear that

4 The poverty measures are from http://iresearch.worldbank.org/povcalnet. Chen and Ravallion (2004a) discuss the data and methods. Trade volumes are from the World Bank's SIMA database and are exports plus imports in current dollars divided by GDP at current dollars (equivalent to calculating both in current prices). Other definitions (such as using GDP at PPP as in Dollar and Kraay 2002, 2004) can give different results; for a discussion of this issue see Milanovic (2004).

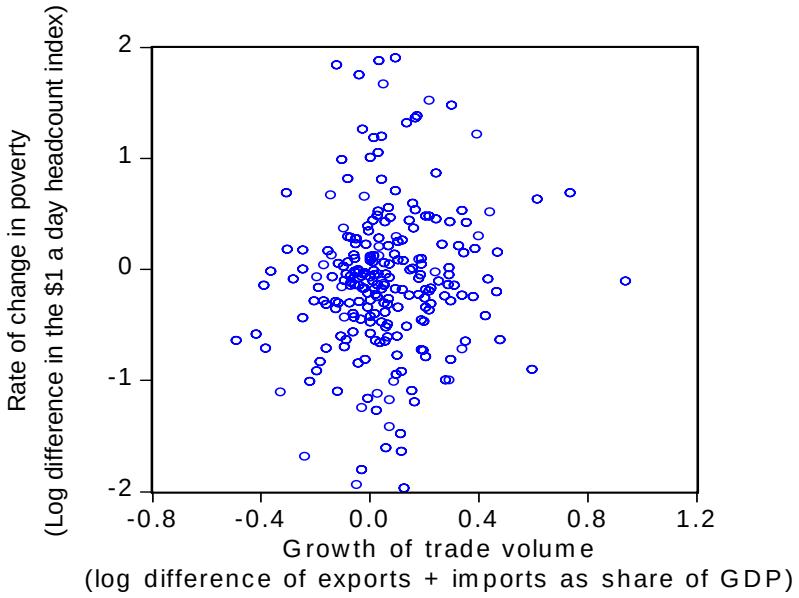
5 The interactions allow the distributional effects of trade to depend on initial income.

6 This is based on a White heteroskedasticity-consistent standard error; without that correction the coefficient is not significant at the 10 per cent level (t= –1.73, prob.=0.09).

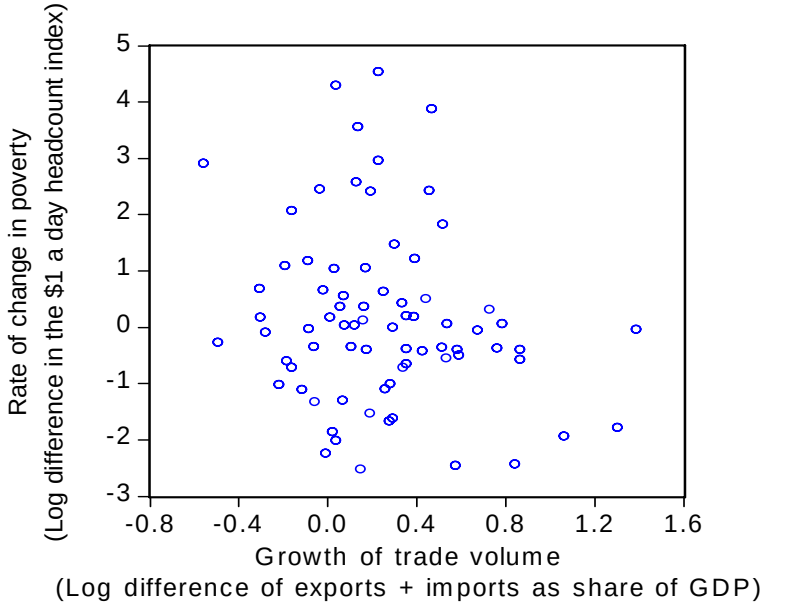
there is considerable variance in rates of poverty reduction at a given rate of expansion in trade volume.

Figure 1
Rate of change in poverty against change in trade volume

(i) All spells



(ii) Longest spells only



The evidence presented above is clearly not anything like an acceptable test for a causal impact of trade volume on poverty. That would require more complete control variables for other time-varying factors correlated with both poverty reduction and trade expansion. However, there can be no presumption that doing so would reveal stronger evidence that trade openness is poverty reducing; indeed, if trade expansion is positively correlated with omitted factors that are good for growth then correcting for this would suggest that trade openness is in fact poverty increasing. And even with extra controls, the aforementioned problems of measurement error suggest that these data may well have rather low power to detect the true relationship. All one might reasonably conclude is that the graphs in Figure 1 cast doubt on any generalization that greater trade openness necessarily means lower poverty in developing countries. There is clearly much more to the story. Rather than attempt to explore the issue further using cross-country regressions, the rest of this article follows rather different approaches.

3 Macro lens 2: Time series analysis for China

China also has the attraction as a case study that going back to the early 1980s allows one to span both a large expansion in trade volume and one of the most dramatic poverty reductions in history; while China's poverty rate today is probably slightly lower than the average for the world as a whole, it was a very different story around 1980 when the incidence of extreme poverty in China was one of the highest in the world.[7] It has been argued by a number of observers that the country's greater openness to external trade since Deng Xiaoping's 'open-door policy' of the early 1980s was the key to the subsequent success against poverty (World Bank 2002; Dollar 2004).

This section tries to test that claim the China's greater trade openness has been an important factor in reducing poverty. The test uses aggregate time series data spanning the period 1980 to 2000. First the poverty measures are described. Then the role of trade openness as a potential explanatory factor is explored, in the context of some competing explanations for China's (undeniable) success against absolute poverty.

Table 1 gives trade share (exports plus imports as a percentage of GDP) and estimates of poverty measures for China over the period 1980-2001; the poverty measures are from Ravallion and Chen (2004) which describes the data and methods in full.[8] The table gives both national poverty measures and the measures for rural areas only.

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7 Chen and Ravallion (2004a) estimate that in 2001, 17 per cent of China's population live below about US$1 a day at 1993 Purchasing Power Parity; the corresponding figure for the world as a whole is 18 per cent (21 per cent for developing countries alone). For 1981, the comparable poverty rate in China is estimated to have been 64 per cent. Only four countries (Cambodia, Burkina Faso, Mali and Uganda) had a higher poverty rate than this in 1981 (based on the estimates from www/iresearch.worldbank.org/povcalnet.)

8 The data are from the National Rural and Urban Households Surveys done by the National Bureau of Statistics (NBS). Ravallion and Chen have made adjustments for the changes in the methods used by NBS in processing the rural data (notably in the valuation methods used for consumption-in-kind from farm production). They have also used new absolute poverty lines from NBS.

Table 1
Trade and poverty in China, 1981-2001

	Trade share (% of GDP)	GDP per capital (Yuan at 1990 prices)	Gini index (%)	Poverty measures (%)					
				National			Rural		
				H	PG	SPG	H	PG	SPG
1981	15.12	808	27.98	52.84	16.17	6.81	64.67	19.99	8.44
1982	14.57	868	25.91	38.14	10.19	3.92	47.78	12.85	4.95
1983	14.49	949	26.02	30.42	7.80	2.85	38.38	9.89	3.63
1984	16.75	1,079	26.89	24.11	5.83	2.01	30.93	7.51	2.58
1985	23.05	1,208	26.45	17.55	4.04	1.33	22.67	5.23	1.71
1986	25.29	1,295	29.20	18.53	4.63	1.65	23.50	5.99	2.16
1987	25.78	1,423	28.90	16.77	4.10	1.45	21.91	5.33	1.83
1988	25.6	1,558	29.50	17.71	4.23	1.47	23.15	5.52	1.89
1989	24.58	1,597	31.78	23.37	6.60	2.65	29.17	7.98	3.05
1990	29.98	1,634	31.55	22.15	5.65	2.04	29.18	7.60	2.76
1991	33.43	1,760	33.10	22.16	6.37	2.61	29.72	8.52	3.43
1992	34.24	1,985	34.24	20.75	5.61	2.27	28.18	7.59	3.03
1993	32.54	2,228	36.74	20.01	5.72	2.29	27.40	7.84	3.13
1994	43.59	2,480	37.60	17.01	5.26	2.32	23.32	7.24	3.19
1995	40.19	2,711	36.53	14.74	4.08	1.58	20.43	5.66	2.16
1996	35.55	2,940	35.05	9.79	2.52	1.07	13.82	3.55	1.50
1997	36.22	3,167	35.00	9.30	2.41	0.87	13.33	3.45	1.23
1998	34.28	3,381	35.37	8.10	1.88	0.65	11.58	2.61	0.81
1999	36.43	3,587	36.37	7.63	1.79	0.60	11.40	2.66	0.85
2000	43.93	3,847	38.49	8.49	2.33	0.89	12.96	3.55	1.33
2001	na	4,105	39.45	7.97	2.13	0.80	12.49	3.32	1.21

Note: Trade share is defined as exports plus imports as % of GDP. H=headcount index; PG=poverty gap index; SPG=squared poverty gap index.

Source: The poverty and inequality measures are from Ravallion and Chen (2004); other data are from the World Bank's SIMA database.

Results are given for three poverty measures: The *headcount index* (H) is the percentage of the population living in households with income per person below the poverty line. The *poverty gap index* (PG) gives the mean distance below the poverty line as a proportion of the poverty line (where the mean is taken over the whole population, counting the non-poor as having zero poverty gaps.) The third measure is the *squared poverty gap index* (SPG), in which the individual poverty gaps are weighted by the gaps themselves, so as to reflect inequality amongst the poor (Foster, Greer and Thorbecke 1984).

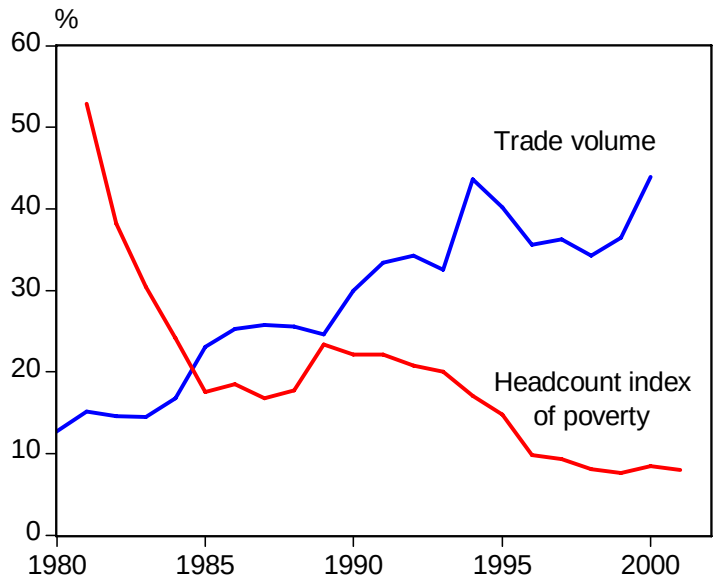
Figure 2 plots both the trade share, which rises from 15 per cent to 44 per cent over the period, and the national headcount index, which falls from 53 per cent to 8 per cent. Certainly a cursory look at Figure 2 might be taken to support the view that expanding trade has reduced poverty. The simple correlation coefficient is –0.75. The regression

coefficient of the log headcount index on the log trade share is –1.11, with a t-ratio of 5.20.

However, trade reform in China must be seen in the context of the many other factors that helped reduce poverty. Here the time profile of China's poverty reduction is instructive. As can be seen in Table 1, there was a dramatic decline in poverty in the first few years of the 1980s; the rural poverty rate fell from 76 per cent in 1980 to 23 per cent in 1985. The late 1980s and early 1990s were more difficult periods for China's poor. Progress was restored around the mid-1990s, though the late 1990s saw a deceleration (Figure 2).[9] The early 1980s saw high growth in agricultural output and rapid rural poverty reduction in the wake of de-collectivization and the privatization of land-use rights under the 'household responsibility system'. (Agricultural land had previously been farmed by organized brigades, in which all members shared the output more-or-less equally.) The literature has pointed to the importance of these reforms in stimulating rural economic growth at the early stages of China's transition (Fan 1991; Lin 1992; Chow 2002).

The sectoral composition of economic growth has clearly played an important role in overall poverty reduction. Ravallion and Chen (2004) divided GDP into 'primary' (mainly agriculture), 'secondary' (manufacturing and construction) and 'tertiary' (services and trade) sectors. The primary sector's share fell from 30 per cent in 1980 to 15 per cent in 2001, though not monotonically. Almost all of this decline was made up for by an increase in the tertiary-sector share. Ravallion and Chen used a regression

Figure 2
Poverty rate and trade volume in China by year



9 Using different measures and data sources, Benjamin, Brandt and Giles (2003) also find signs of falling living standards amongst the poorest in rural China in the late 1990s.

decomposition method to test whether the source of growth mattered to the rate of poverty reduction. They found that primary sector growth had far higher impact (by a factor of about four) than either the secondary or tertiary sectors. The regression coefficient on the (share-weighted) growth rate in primary-sector GDP was four times higher than for either the secondary or tertiary sectors and the impacts of the latter two sectors were similar (and one cannot reject the null hypothesis that they have the same impact). With a relatively equitable distribution of access to agricultural land and higher incidence and depth of poverty in rural areas it is plausible that agricultural growth would have brought large gains to China's poor.

Agricultural pricing policies also played a role. Until recently, the government has operated a domestic foodgrain procurement policy by which farmers are obliged to sell fixed quotas to the government at prices that are typically below the local market price. For many farmers this is an infra-marginal tax, given that they produce more foodgrains than their assigned quota; for others it will affect production decisions at the margin. Reducing this tax by raising procurement prices stimulated primary sector GDP. Ravallion and Chen (2004) find a strong correlation between the growth rate of primary sector output and the real procurement price of foodgrains (nominal price deflated by the rural CPI). There is both a current and lagged effect. The impact on agricultural incomes in turn meant lower poverty measures.

Another factor in China' success against poverty was macroeconomic stability. When one controls for procurement price changes, Ravallion and Chen (2004) find an adverse effect of lagged changes in the rate of inflation for all three poverty measures. There are also strong (pro-poor) distributional effects of higher procurement prices and inflationary shocks. This is consistent with evidence for other developing countries indicating that inflation hurts the poor.[10] The adverse impacts on poor people of inflationary shocks probably stem from short-term stickiness in some of the key factor and output prices determining their real incomes.

Returning to the question of what role trade reform has played in China's success against poverty, there are reasons to be sceptical of the correlation in Figure 2. We have seen that a number of other factors were at work. Granted, trade reforms had also

Table 2
China's barriers to external trade

	Mean tariff rates (%)				Incidence of non-tariff barriers (%)			
	1980-83	1984-87	1988-90	1991-93	1980-83	1984-87	1988-90	1991-93
Primary	22.7	20.6	19.1	17.8	na	19.7	58.9	40.7
Manufactured	36.6	33.2	34.3	37.1	na	16.1	34.4	19.2
All products	31.9	29.2	29.2	30.6	na	17.2	42.6	26.4

Source: Weighted averages from UNCTAD (1994).

10 See Easterly and Fischer (2001) and Dollar and Kraay (2002) both using cross-country data, and Datt and Ravallion (1998) using data for India.

Table 3
Time series regressions for China's poverty measures

	Headcount index		Poverty gap index		Squared poverty gap index	
Constant	-0.048 (-1.230)	-0.063 (-1.834)	-0.050 (-0.921)	-0.061 (-1.332)	-0.041 (-0.663)	-0.053 (-1.048)
Poverty measure (-1)	0.140 (0.735)	–	0.089 (0.431)	–	0.093 (0.388)	–
Real procurement price	-0.728 (-1.509)	–	-0.881 (-1.313)	–	-0.678 (-0.878)	–
Real procurement price (-1)	-1.222 (-3.069)	-1.412 (-3.773)	-1.613 (-2.887)	-1.837 (-3.660)	-1.973 (-3.067)	-2.162 (-3.913)
Inflation rate	0.294 (0.530)	–	0.378 (0.485)	–	0.325 (0.362)	–
Inflation rate (-1)	1.836 (2.671)	1.404 (2.587)	2.193 (2.298)	1.646 (2.272)	2.257 (2.055)	1.865 (2.338)
Trade volume	-0.319 (-1.296)	-0.207 (-0.879)	-0.173 (-0.499)	-0.034 (-0.107)	0.096 (-0.240)	0.018 (0.053)
Trade volume (-1)	0.111 (0.449)	0.028 (0.117)	0.039 (0.113)	-0.034 (-0.104)	0.001 (0.003)	-0.057 (-0.159)
R^2	0.666	0.560	0.609	0.530	0.601	0.562
D-W	2.501	1.960	2.661	2.256	2.502	2.079

Note: All variables in logs and differenced over time. T-ratios in parentheses.

started in the early 1980s as part of Deng Xiaoping's 'open-door policy'—mainly entailing favourable exchange rate and tax treatment for selected exporters and creation of the first special-economic zone, Shenzhen, near Hong Kong. However, the bulk of the trade reforms did not occur in the early 1980s, when poverty was falling so rapidly, but were later, notably with the extension of the special-economic zone principle to the whole country (in 1986) and from the mid-1990s, in the lead up to China's accession to the World Trade Organization (WTO). Table 2 shows that mean tariff rates fell only slightly in the 1980s and non-tariff barriers actually increased. And some of the trade policies of this early period were unlikely to have been good for either equity or efficiency.[11] Arguably the bulk of China's trade reform has been after the times of most rapid poverty reduction, and (indeed) in times of relatively stagnant poverty measures.

On closer inspection, Figure 2 looks suspiciously like a spurious correlation, driven by common time trends. The Durbin-Watson statistic from the regression of log headcount index on log trade volume is 0.42. Allowing for deterministic trends and one year's lag in first differences, the Johansen test rejects cointegration between the log of the headcount index and the log of trade share; the same holds for both the poverty gap and squared poverty gap. (Nor, for that matter, is log GDP per capita cointegrated with trade share.) These data are not consistent with existence of a stable long-run relationship between

[11] For example, a two-tier price system allowed exporters to purchase commodities at a low planning price and then export them at a profit. For this reason, oil was a huge export item until 1986.

trade volume and poverty in China. The correlation between trade and poverty vanishes if one looks instead at the changes over time. The simple correlation between changes in trade volume and changes in the log headcount index is 0.00!

Allowing for both current and lagged effects of the aforementioned variables in a multivariate dynamic model, Table 3 gives estimates of the following regression for the changes over time in the log poverty measures:

$$\begin{aligned}\Delta \ln P_t &= \alpha_0 + \alpha_1 \Delta \ln P_{t-1} + \beta_0 \Delta \ln PP_t + \beta_1 \Delta \ln PP_{t-1} \\ &+ \gamma_0 \Delta^2 \ln CPI_t + \gamma_1 \Delta^2 \ln CPI_{t-1} + \gamma_0 \Delta \ln T_t + \gamma_1 \Delta \ln T_{t-1} + \varepsilon_t\end{aligned} \tag{1}$$

where P is the poverty measure, PP is the real procurement price for foodgrains (nominal price deflated by rural CPI), CPI is the rural CPI (so $\Delta \ln CPI$ is the inflation rate) and T is the trade volume (ratio of exports plus imports to GDP). Table 3 also gives a more parsimonious specification (that passes the joint parameter tests) which keeps the trade variables but drops other (jointly and individually) insignificant variables. Again, for all three poverty measures, there is no sign of any significant effect of current or lagged trade volume on poverty in China.

Notice also that equation (1) does not include measures of aggregate economic growth since it can be argued that there might be important channels through which trade reduced poverty. However, it is of interest to repeat these tests adding the difference in log mean income to equation (1) to see if there was any sign of a distributional effect of trade volume. On doing so one again finds that both current and lagged trade volume are highly insignificant. (The effects of procurement prices and inflation remained strong however; indeed, they became more significant when the change in log mean was added to equation (1).)

Three caveats are of note. First, trade volume may well be endogenous in this test, though it is not clear that correcting for the bias would imply that trade played a more important role against poverty. This would require that changes in trade volume are positively correlated with the omitted variables. However, one would probably be more inclined to argue that trade volume is negatively correlated with the residuals in a regression for poverty on the grounds that other (omitted) growth-promoting policies are more likely to simultaneously increase trade and reduce poverty.

Second, the gains to China's poor may well take a longer time to be realized than these regressions allow. For example, longer lags may be needed to capture the gains through higher factor productivity associated with trade-induced adoption of new technologies.

Third, the 'open-door policy' may well have had other poverty-reducing effects not evident in higher trade volume. For example, greater openness may have facilitated the rise in domestic procurement prices for foodgrains, to help line up domestic prices with world prices. This effect might not be reflected in trade volume. (Trade expansion is not strictly necessary to shift the prices of tradable goods.)

Though recognizing these caveats, a closer look at the time series evidence for China casts doubt on the view that greater openness to external trade has been the driving force in poverty reduction. Indeed, it is hard to even make the case from the available

data that trade has helped the poor on balance. More plausible candidates for explaining China's success against poverty can be found in the role played by the agrarian reforms starting in the late 1970s, subsequent agricultural growth (which had an unusually large impact on poverty given a relatively equitable allocation of land achieved in the wake of the early reforms to de-collectivize agriculture), reduced taxation of farmers, and macroeconomic stability.

4 Micro lens 1: Household impacts of WTO accession in China

Aggregate inequality or poverty need not change with trade reform even though there are both gainers and losers at all levels of living. Numerous sources of such 'horizontal' impacts of policy reform can be found in developing country settings. For example, geographic disparities in access to human and physical infrastructure affect prospects for participating in the opportunities created by greater openness to external trade. To give another example, differences in the demographic composition of families will influence consumption behaviour and hence the welfare impact of the shifts in relative prices often associated with trade openness.

We now turn to a very different method, which has often been used as a macro lens, but can also throw useful light on the micro impacts. By this method, the price and wage effects of trade reform are first simulated using a computable general equilibrium (CGE) model and are then passed onto a household survey to estimate welfare effects at household level.[12] One typically then aggregates up to obtain the effects on measures of poverty. However, as we will see, much can also be learnt from the disaggregated impact estimates.

The strength of this approach is that minimum aggregation can be imposed on the analysis of welfare impacts. Even if the trade reforms have little effect on income distribution in the aggregate, the impacts may vary across household types and regions, given the likely heterogeneity in net trading positions in relevant markets. In China, for example, the economic geography of the impacts of policy reforms is high on the domestic policy agenda. Considerable geographic diversity in the welfare impacts of economy-wide reforms can be anticipated. An analysis that simply averaged over such differences would miss a great deal of what matters to the policy debate.

This approach has its limitations too. Four limitations should be noted: First, the CGE and household-level analyses are not integrated, which would require an extraordinarily high dimensional CGE model in this case (with 85,000 households in the survey).[13] While, the micro simulations are based on economic assumptions that are consistent with the CGE model—notably that households take prices as given and those prices

[12] In an antecedent to this approach, Bourguignon, Robilliard and Robinson (2003) take price changes generated by a CGE model to survey data for Indonesia. The methodological differences are discussed in Chen and Ravallion (2004b).

[13] One of the (very few) examples of full integration is Cockburn (2002) who built a classic trade-focused CGE model onto the Nepal Living Standards Survey covering about 3,000 households.

clear all markets—no attempt is made to assure full consistency between the micro-analysis and the CGE model's predictions.

Second, the method does not readily identify certain dynamic gains from greater trade openness. There are ways that the economy might respond to trade-induced price and wage changes that are not captured. For example, trade may facilitate learning about new technologies and innovation that brings longer-term gains in productivity. There may also be response through labour mobility, which could be expected to attenuate horizontal welfare impacts at given real income.

Third, the method relies on linear approximations in a neighbourhood of an initial equilibrium. This may be deceptive if the price or wage changes are large, or the household was initially out-of-equilibrium, such as due to rationing (including involuntary unemployment of labour). In principle there are ways of dealing with these problems by estimating complete demand and supply systems. This may prove a fruitful avenue for future research and there are some examples in the literature,[14] though it should be noted that these methods generate their own problems, such as arising from incomplete data on price and wage levels at household level.

Finally, the geographic differences in welfare impacts arise entirely from differences in consumption and production behaviour. In reality, there are also likely to be differential impacts on local prices, due to transport or other impediments to internal trade. As implemented in this case study, the approach does not incorporate such differences, and doing so would pose a number of data and analytic problems. This might, however, be a fruitful direction for future work in settings in which one has the necessary geographic data on prices and wages.

While acknowledging these limitations, the approach used here can at least illuminate the likely short-term poverty impacts of trade reforms.

4.1 Measuring the welfare impacts of trade reform

WTO accession in China meant a sharp reduction in tariffs, quantitative restrictions, and export subsidies, with implications for the domestic structure of prices and wages and thus for household welfare and its distribution. In measuring the welfare impacts of this trade reform, prior estimates of the direct and indirect impacts of China's WTO accession on goods and factor prices are combined with standard methods of first-order welfare analysis to measure the gains and losses at the household level. The welfare impacts are derived from a household model that incorporates own-production activities. The analytics are summarized in the Appendix.

This approach respects the richness of detail that is available from a modern integrated household survey, allowing one to go well beyond the highly aggregative types of analysis presented in sections 2 and 3. One can measure the expected impacts across the distribution of initial levels of living, but also look at how the impacts vary by other household characteristics, including location and demographic characteristics. Thus one

14 See, for example, Ravallion and van de Walle (1991) and Porto (2004).

can provide a reasonably detailed 'map' of the predicted welfare impacts by location and socioeconomic characteristics. Details of the implementation for China are given in Chen and Ravallion (2004b). This discussion will focus on the salient results for the purposes of this paper.

The price changes induced by the trade policy change are simulated from the computable general equilibrium model used by Ianchovichina and Martin (2004). This is a competitive market-clearing model from the Global Trade Analysis Project (GTAP).[15]

The CGE model is applied to household survey data. The CGE analysis generates a set of price and wage changes; these embody both the direct price effects of the trade policy change and 'second-round' indirect effects on the prices of non-traded goods and on factor returns, including effects that operate through the government's budget constraint. Since the price changes are based on an explicit model, their attribution to the trade-policy reform is unambiguous. The survey data come from the 1999 Rural Household Survey (RHS) and the 1999 Urban Household Survey (UHS), both carried out by China's National Bureau of Statistics (NBS). The RHS sample covers 67,900 households and the UHS, 16,900. NBS also kindly provided the micro data for three provinces (Liaoning, Guangdong, and Sichuan), which can be termed the 'test provinces'. The computer programme to implement our estimation method was written for these data, after which NBS staff ran the programme on the entire national data set. (The complete micro data files are not publicly available.)

4.2 Impacts on aggregate poverty

Before China's official WTO accession in 2001, the economy had already started to adapt to the expected change. One can thus consider the trade reform as having two stages: a lead-up period, in which tariffs started to fall in anticipation of WTO accession, and the period from 2001 onwards. Ianchovichina and Martin (2004) argue that one can take 1995 as a plausible beginning of the lead-up period, and the analysis here uses their estimates of the changes in goods and factor prices induced by WTO accession for the periods 1995-2001 and 2001-07.

For the first stage of this trade reform, the simulated income distribution is obtained by subtracting the estimated gains over 1995-2001 from the 1999 incomes at household level. For the second stage, the impacts are obtained by adding the household-specific gains from 2001-07 to the 1999 incomes. Thus the first simulation tells us the distributional impact of the price changes during the first stage of the reform—what the baseline distribution would have looked like without the reforms—while the second tells us the impact of the post-2001 price changes—that is, how those changes are expected to affect the baseline distribution, looking forward.

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15 Hertel (1997) contains a useful compendium of papers describing the standard GTAP model with applications. A full discussion of the assumptions of the general equilibrium model and the results of its application to China's accession to the WTO can be found in Ianchovichina and Martin (2004).

Table 4
Predicted aggregate impacts of WTO accession in China

	Rural	Urban	National
	Mean gains (Yuan/capita)		
1995-2001	34.47	94.94	55.49 (1.54%)*
2001-07	-18.07	29.45	-1.54 (-0.04%)*
	Poverty impacts (Headcount index, %)		
Official poverty line			
Baseline (1999)	4.38	0.08	2.92
Simulated: Less gains 1995-2001	4.56	0.08	3.04
Simulated: Plus gains 2001-07	4.57	0.07	3.04
US$1/day (1993 PPP)			
Baseline (1999)	10.51	0.29	7.04
Simulated: Less gains 1995-2001	10.88	0.28	7.28
Simulated: Plus gains 2001-07	10.81	0.28	7.23
US$2/day (1993 PPP)			
Baseline (1999)	45.18	4.07	31.20
Simulated: Less gains 1995-2001	46.10	4.27	31.88
Simulated: Plus gains 2001-07	45.83	3.97	31.60

Notes: * gives percentage of mean income. PPP is purchasing power parity.
Source: Chen and Ravallion (2004b).

Table 4 summarizes the results. The upper panel gives the mean gains for each of the periods 1995-2001 and 2001-07, split by urban and rural areas. The lower panel gives the headcount index of poverty as measured by various poverty lines; the 'official poverty line' gives estimates based on the poverty lines used by the NBS, while the 'US$1/day' and US$2/day' lines are those from Chen and Ravallion (2004a).

We find an overall gain of about 1.5 per cent in mean income, all in the period leading up to WTO accession. We find that in 1999 the incidence of poverty would have been slightly higher if not for the trade policy changes over the lead-up period to WTO accession. From 2001 to 2007, poverty is projected to increase very slightly as a result of the price changes expected to be induced by the remaining tariff changes.

The impacts over a wide range of poverty lines can be seen from Figure 3, which gives the cumulative distributions of income for both the baseline and the two simulated distributions, for the poorest 60 per cent in rural areas (Figure 3a) and the poorest 40 per cent in urban areas (Figure 3b). There is negligible impact across a wide range of the distribution.

Figure 3a
Poverty incidence curves: rural

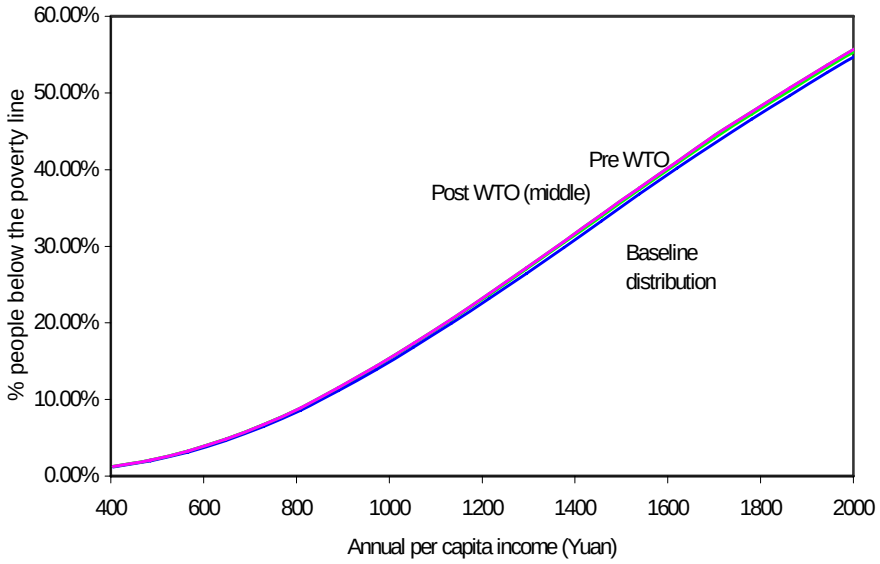
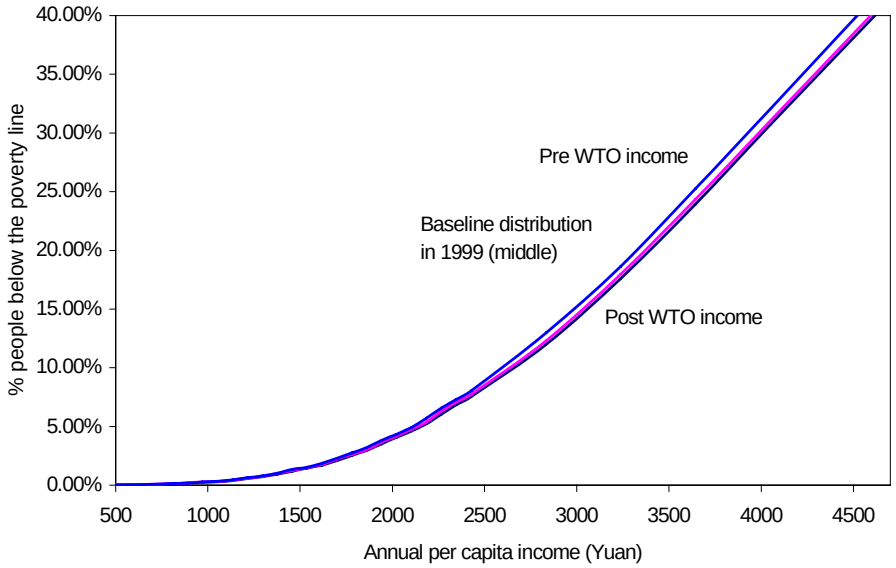


Figure 3b
Poverty incidence curves: urban



4.3 Gainers and losers from trade reform

Although using very different data and methods, the results of the last section are consistent with those of section 3 in suggesting that trade openness in China has had negligible effect on poverty in the aggregate. However, with this new micro lens we can also study the heterogeneity in impacts.

Figure 4
Mean gain by percentile of households ranked by income per person

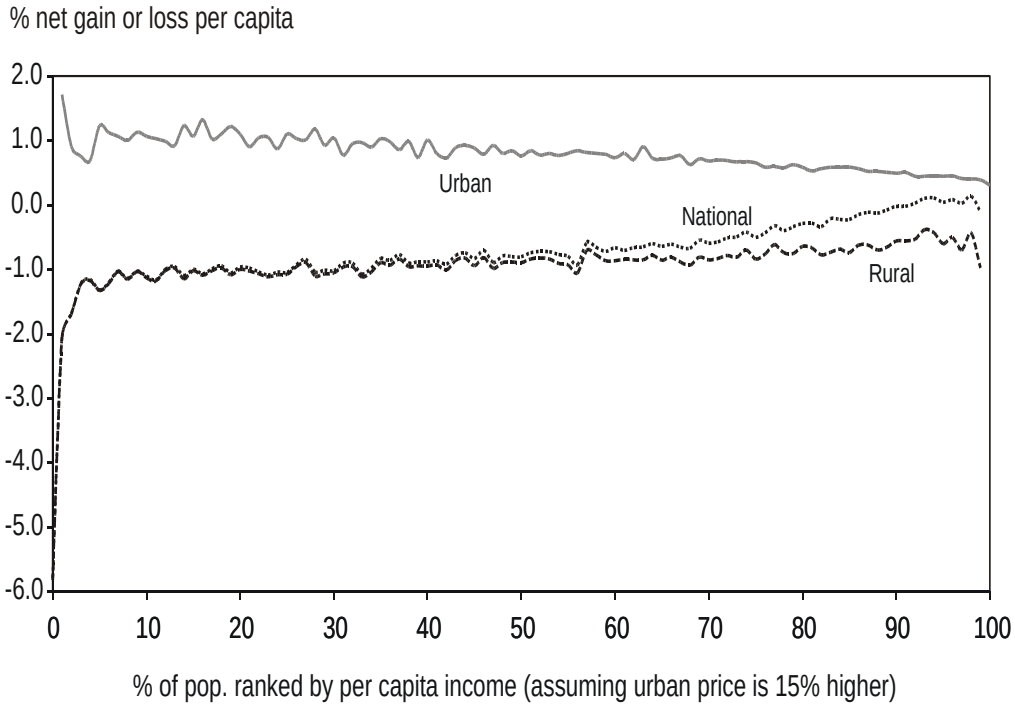


Figure 5
Percentage of gainers, by income percentile

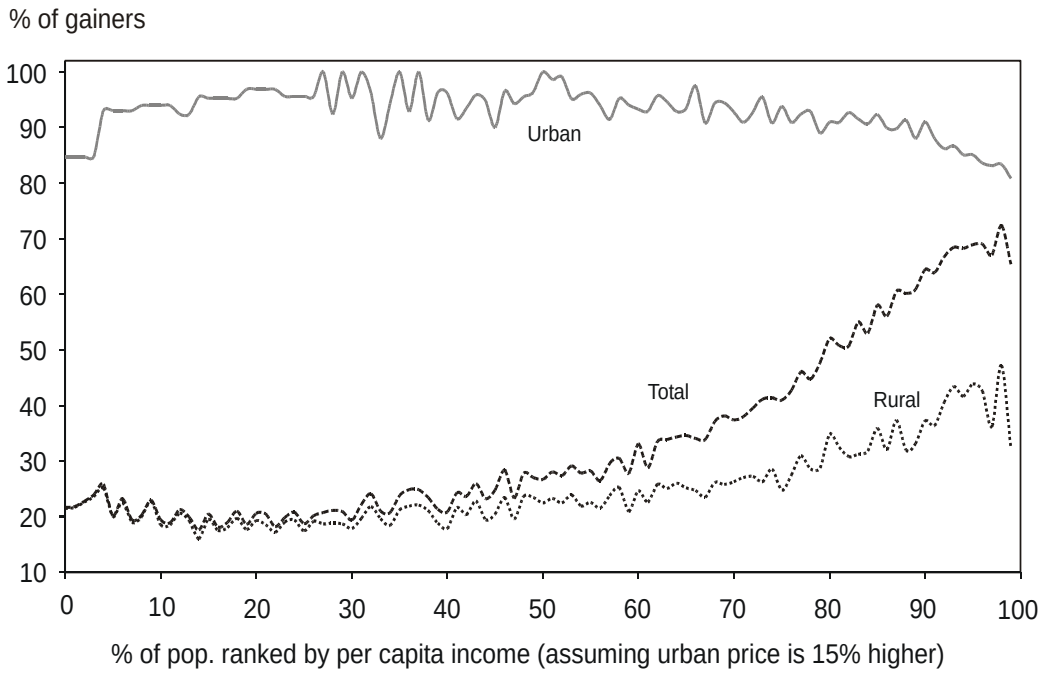


Figure 4 shows how the incidence of gains varies by income. The generally positive gains amongst urban households tend to fall slightly (as a proportion of income) as income rises. The generally negative impacts for rural households reach quite high levels amongst the very poorest. Farm income is predicted to fall due to the drop in the

wholesale prices of most farm products (plus higher prices for education and health care; see Chen and Ravallion 2004b, for details). About three-quarters of rural households are predicted to lose real income in the period 2001-07 (Figure 4). This is true for only one in ten urban households.

Impacts also differ widely across regions. One spatially contiguous region stands out as losing the most from the reform: namely the northeast provinces of Heilongjiang, Jilin, Inner Mongolia, and Liaoning. Both the absolute and proportionate impacts are highest in this region—indeed, more than 90 per cent of farmers in Heilongjiang and Jilin are predicted to experience a net loss in income (Chen and Ravallion 2004b).

Which types of households gain and which lose? The Appendix outlines how a regression specification for addressing this question can be derived from the welfare analysis of the impacts of trade reform. The household characteristics considered included age and age-squared of the household head, education and demographic characteristics, and land (interpreted as a fixed factor of production, since it is allocated largely by administrative means in rural China). Dummy variables are also included to describe some key aspects of the occupation and principal sector of employment, such as whether the household is a registered agricultural household, whether its members engage in wage employment, are employed by the state, or participate in township and village enterprises.

Table 5 gives the regressions for the three test provinces (for which the micro data are available); Table 5a is for rural areas while 5b is urban. Looking first at rural areas, we find that in all three provinces, the predicted gain from trade reform tends to be larger for larger households. There is also a U-shaped relationship with the age of the household head, such that the gains reach a minimum around 50 years of age. The gains are smaller for agricultural households. They are larger for households with more employees, more workers in township and village enterprises, more migrant workers, and less cultivated land (though the last finding is only significant in Liaoning). The only strong demographic effect is that younger households (those with a higher proportion of children under six) tend to be gainers in Liaoning.

For agricultural households, predicted losses are significantly higher than average in six counties in Liaoning (losses of 3 to 5.6 per cent, versus the provincial average of 1.3 per cent), seven in Guangdong (2.5 to 5.3 per cent, versus the provincial average of 0.8 per cent), and six in Sichuan (2.8 to 5.7 per cent, versus the provincial average of 0.7 per cent).

In urban areas, the gains tend to be larger for smaller households. As in rural areas, there is a U-shaped pattern (except in Liaoning), with the smallest gains for households whose heads were 66 years of age in Guangdong and 51 years in Sichuan. By contrast with rural areas, there is no relationship between education levels and welfare gains in urban areas tend to be larger for less well-educated households. There are signs of some sectoral effects, though only significantly so in Liaoning, with higher gains for those in government jobs. There are signs of larger gains among those whose employer is the government. Retirees tend to gain less than others.

Table 5a
Regressions for percentage gains from trade reform in three provinces, Rural areas

	Liaoning		Guangdong		Sichuan	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
Log of household size	0.768	2.46	0.022	0.20	0.030	0.40
Age of household head	-0.108	-2.17	-0.007	-0.34	-0.004	-0.31
Squared age	0.001	2.19	0.000	0.40	0.000	-0.02
Agriculture household	-0.896	-2.98	-1.365	-14.85	-1.420	-7.58
# of employee/hh size	0.630	2.76	0.271	2.57	0.444	3.61
# of TVE workers/hh size	0.669	4.27	0.585	4.47	0.548	6.11
# of migrate workers/hh size	0.655	3.59	0.187	3.59	0.346	7.08
Area of cultivated land	0.000	-1.77	0.000	-0.73	0.000	-1.61
Area of hilly land	0.000	-0.48	0.000	-0.35	0.000	2.20
Area of fishpond land	0.000	-0.17	-0.001	-2.23	0.000	0.55
Highest education level is						
… illiterate or semi-illiterate	1.393	2.18	0.507	1.26	-0.013	-0.05
… primary school	-0.634	-2.01	-0.154	-0.90	0.069	0.30
… middle school	-0.891	-3.08	-0.023	-0.14	-0.011	-0.05
… high school	-0.660	-2.42	0.010	0.06	0.006	0.02
… technical school	-0.573	-1.87	-0.229	-1.18	0.038	0.14
… college (default)						
Ratio of labour force	0.456	0.85	0.323	1.81	-0.099	-0.71
Ratio of children under 6	3.730	3.61	0.461	1.49	-0.169	-0.78
Ratio of children age 6-11	1.557	1.41	0.173	0.72	-0.275	-1.48
Ratio of children age 12-14	1.625	1.54	-0.477	-1.60	-0.343	-1.85
Ratio of children age 15-17	1.325	1.80	-0.289	-0.91	-0.192	-0.88
Constant	0.788	0.69	-0.709	-1.39	-0.584	-1.68
R-square	0.108		0.217		0.171	

Table 5b
Regressions for percentage gains from trade reform in three provinces, Urban areas

	Liaoning		Guangdong		Sichuan	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
Log of household size	0.175	3.54	-0.038	-0.4	0.036	0.46
Single head h'hold	-0.022	-0.36	-0.221	-2.21	-0.259	-3.07
Age of household head	0.000	-0.01	0.033	2.55	0.017	1.53
Squared age	0.000	0.1	0.000	-2.12	0.000	-1.46
Highest education level (default is university)						
… primary school or lower	0.524	6.43	0.389	3.7	0.509	5.15
… middle school	0.539	10.41	0.583	7.25	0.591	8.27
… high school	0.180	3.56	0.095	1.46	0.262	3.83
… technical school	0.214	4.04	0.076	1.22	0.120	1.79
… college	0.054	1.04	0.015	0.25	0.125	2.24

Table 5b continues

Table 5b (con't)
Regressions for percentage gains from trade reform in three provinces, Urban areas

	Liaoning		Guangdong		Sichuan	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
Sector (default is govt.)						
... agriculture	-0.079	-0.32	0.166	2.2	0.338	2.64
… mining	0.183	1.11	0.346	3.38	-0.129	-1.01
… manufacturing	-0.015	-0.27	0.114	1.41	-0.021	-0.34
… utility	-0.040	-0.36	-0.144	-1.18	-0.134	-0.84
… construction	0.095	0.91	0.109	1.19	0.036	0.51
… geological prospecting & water conservancy	-0.407	-3.06	0.178	1.03	-0.228	-0.53
… trans. & telecom.	0.206	2.93	0.060	0.79	-0.036	-0.4
… wholesale & retail etc.	0.060	0.78	0.081	0.99	-0.015	-0.18
… banking & finance	-0.088	-0.47	0.049	0.53	0.013	0.12
… real estate	-0.108	-0.91	0.222	1.16	0.106	0.29
… social services	-0.090	-1.09	0.065	0.69	0.148	1.37
… health care etc.	-0.088	-1.1	0.007	0.06	-0.124	-1.49
… education etc.	-0.057	-0.75	0.044	0.44	-0.031	-0.39
… scientific research	-0.454	-4.09	0.126	1.11	-0.082	-0.73
... others	0.012	0.14	0.034	0.25	-0.121	-0.55
Type of employer (default is state owned)						
… collective-owned	0.053	1.16	0.008	0.08	0.137	1.73
… foreign company	-0.046	-0.54	-0.122	-2.3	-0.193	-2.08
… private-business owner	-0.069	-0.59	-0.051	-0.39	0.317	2.46
.. private-owned	-0.182	-1.65	-0.231	-1.96	-0.037	-0.22
.. retirees re-employed	-0.302	-3.39	-0.242	-1.41	-0.177	-1.32
.. retirees	-0.341	-4.2	-0.452	-2.37	-0.359	-3.42
.. others	-0.124	-1.13	-0.187	-1.24	-0.338	-1.2
Occupation (default is retiree)						
Engineer & technician	-0.015	-0.14	-0.141	-0.69	-0.036	-0.29
Officers	-0.044	-0.43	-0.063	-0.31	-0.045	-0.36
Staff in commerce	0.012	0.12	-0.036	-0.17	0.029	0.24
Staff in services	0.437	3.08	0.019	0.09	-0.011	-0.08
worker in manufactory etc.	0.118	0.82	0.025	0.12	0.091	0.56
worker in trans. & telecom.	0.209	2.02	-0.018	-0.09	0.130	1.03
Other	0.171	1.33	-0.069	-0.27	-0.636	-4.2
Constant	0.172	0.7	-0.623	-1.68	-0.197	-0.71
R-square	0.401		0.290		0.359	

5 Micro lens 2: Cereal de-protection in Morocco

We now turn to a second case study using the micro lens. The desire for aggregate self-sufficiency in the production of food staples in Morocco 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 per cent. Reform to this policy would entail a sharp reduction in tariffs, with implications for the domestic structure of prices and hence household welfare.

A joint government of Morocco and World Bank Committee developed a CGE analysis of the impacts of cereal de-protection (World Bank 2003; Doukkali 2003). Starting from the results of that study, Ravallion and Lokshin (2004) applied standard methods of first-order welfare analysis (very similar to those described above for the China case study in the previous section) to measure the gains and losses at household level using a large sample survey, namely the Morocco Living Standards Survey for 1998/99 covering a nationally representative sample of 5,000 households. A detailed exposition of the data and methods can be found in Ravallion and Lokshin (2004). This section merely summarizes the results of relevance to the present paper.

The micro lens available from household-level analysis throws into question past claims about the likely welfare impacts of this trade reform. In the aggregate, the study found a negligible impact of partial de-protection on the poverty rate; for example, with a tariff cut on imported cereals of 30 per cent the headcount index is predicted to rise from 19.6 per cent to 20.3 per cent. With complete de-protection the impact was slightly larger, with the headcount index rising to 22.1 per cent. Note that this is only the impact of changes in prices; longer-term positive impacts on agricultural productivity are not factored in. The original CGE analysis also assumed fixed wages, so this channel of impacts is also closed off.[16]

There was a sizeable, and at least partly explicable, variance in impacts across households. The simulations suggest that rural families tend to lose; urban households tend to gain. There are larger impacts in some provinces than others, with highest negative impacts for rural households in Tasla Azilal, Meknes Tafil, Fes-Boulemane and Tanger-Tetouan. Mean impacts for rural households in these regions are over 10 per cent or more of consumption. There are sizeable expected welfare losses amongst the poor in these specific regions.

The adverse impact on rural poverty stems in large part from the fact that in value terms 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 past generalizations that the rural poor in Morocco tend to be net consumers of grain, and hence gainers from trade reform. However, a majority of Morocco's poor are net consumers, even though on balance the welfare impacts on the rural poor are negative.

16 This is not a particularly appealing assumption, but we have no choice given that it was made in the original Government of Morocco-World Bank Committee in making its projections of the impacts of trade reform.

There are predicted to be more gainers than losers amongst the rural poor, but the aggregate losses outweigh the aggregate gains.

These results again lead one to question the high level of aggregation common in past claims about welfare impacts of trade reform. As in the China case, the Morocco study finds diverse impacts at given pre-reform income levels. This 'horizontal' dispersion becomes more marked as the extent of reform (measured by the size of the tariff cut) increases (Ravallion and Lokshin 2004). It is clear from these results that in understanding the social impacts of this reform, one should not look solely at income poverty as conventionally measured; rather one needs to look at impacts along 'horizontal' dimensions, at given income.

6 Conclusions

Each of the (rather different) empirical approaches used here casts doubt on any presumption that greater openness to external trade is the key to rapid poverty reduction. Equally well they cast doubt on any presumption that trade openness hurts more poor people than it helps.

Pooling data on spells of poverty reduction across countries and over time, matched with measures of the extent of trade openness, does not reveal any correlation between rates of poverty reduction and expanding trade volume. Focusing on the longest time periods available for each country, one can unearth a positive correlation between greater trade openness over time and rates of poverty reduction. However, the correlation is rather fragile, and the data are more suggestive of diverse (and noisy) impacts of trade openness on poverty. Based on the data available from cross-country comparisons, it hard to maintain the view that trade openness is, in general, a powerful force for poverty reduction in developing countries.

Nor does the aggregate time series evidence data assembled here for China suggest that trade reform has been an important factor in reducing poverty. A range of 'non-trade' factors appear to have played a more important role in explaining China's (considerable) success against absolute poverty since the early 1980s.

More disaggregated analyses of the household-level impacts of trade reforms in both China and Morocco are broadly consistent with these conclusions. WTO accession in China is found to have a small poverty-reducing effect in the aggregate. Cereal de-protection in Morocco is predicted to have a only a small adverse impact on poverty in the aggregate.

However, in both China and Morocco, a micro empirical lens points to considerable heterogeneity in impacts underlying the aggregates. There is a sizeable, and at least partly explicable, variance in impacts across households with different characteristics. In both countries, rural families tend to lose; urban households tend to gain. Impacts are much larger in some geographic areas than others. For example, in China the adverse impacts are largest in the northeast, where rural households depend more on feedgrain production (for which falling prices are expected from WTO accession). The most

vulnerable households tend to be rural, dependent on agriculture, with relatively few workers, and with weak economic links to the outside economy though migration.

The macro perspective also hides potentially important implications for other areas of policy. The findings reported here have implications for social protection policy, in conjunction with trade reform. There are clear covariates of micro impacts that can be exploited in designing compensatory policies. The latent heterogeneity in impacts is undoubtedly driven in part by measurement errors but it also points to the likely need for self-targeting mechanisms that do not rely on readily measured statistical indicators of impact.

Appendix: Calculating and modelling welfare impacts

The following exposition relates to the China case study reported in section 4; the Morocco study used slightly different assumptions as outlined in Ravallion and Lokshin (2004).

A competitive general equilibrium model is first used to simulate the impacts on factor and goods prices of trade reform. The CGE model is described in Ianchovichina and Martin (2004). In carrying these impacts to the household level, each household has preferences for 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 labour supplies by activity, including supply to the household's own production activities. (Commodities have positive marginal utilities while labour supplies have negative marginal utilities.) Each household is assumed to be free to choose its preferred combinations of q_i^d and L_i subject to its budget constraint. Thus (consistently with the CGE model that generated the price and wage changes) there is no rationing at household level; for example, involuntary unemployment is ruled out. It follows that all welfare impacts of trade reform are passed onto households via changes in the goods and factor prices that they face.

To calculate the monetary value of the welfare impact of price changes, one can work with the standard indirect utility function of household *i* as given by:

$$v_i[p_i^d, w_i, \pi_i] = \max_{(q_i^d, L_i)} [u_i(q_i^d, L_i) \,|\, p_i^d q_i^d = w_i L_i + \pi_i] \qquad \text{(A1)}$$

where p_i^d is the price vector for consumption, w_i is the vector of wage rates and π_i is the profit obtained from all household enterprises as given by:

$$\pi_i(p_i^s, p_i^d, w_i) = \max_{(z_i, L_i^o)} [p_i^s q_i^s - p_i^d z_i - w_i L_i^o \,|\, q_i^s = f_i(z_i, L_i^o)] \qquad \text{(A2)}$$

where p_i^d is the vector of supply prices, q_i^s is the vector of quantities supplied, L_i^o is the labour input to the own production activities, f_i is the household-specific production function (embodying fixed factors) and z_i are quantities of commodities used as production inputs.

Taking the differentials of equations (A1) and (A2) and using the envelope property (whereby the welfare impacts in a neighbourhood 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:

$$g_i \equiv \frac{du_i}{v_{\pi i}} = \sum_{j=1}^{m} [p_{ij}^s q_{ij}^s \frac{dp_{ij}^s}{p_{ij}^s} - p_{ij}^d (q_{ij}^d + z_{ij}) \frac{dp_{ij}^d}{p_{ij}^d}] + \sum_{k=1}^{n} (w_k L_{ik}^s \frac{dw_k}{w_k}) \qquad \text{(A3)}$$

where $v_{\pi i}$ is the marginal utility of income for household *i* (the multiplier on the budget constraint in equation A1) and $L_{ik}^s = L_{ik} - L_{ik}^o$ is the household's 'external' labour supply to activity *k*. (Notice that gains in earnings from labour used in own production are exactly matched by the higher cost of this input to own-production.) The proportionate changes in all prices and wages are weighted by their corresponding expenditure and income 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 $-p_{ij}^d (q_{ij}^d + z_{ij})$ 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 $p_{ij}^s q_{ij}^s - p_{ij}^d (q_{ij}^d + z_{ij})$ can be thought of as 'net revenue', which (to a first-order approximation) gives the welfare impact of an equi-proportionate increase in the price of commodity *j*. Equation (A3) is the key formula for calculating the welfare impacts at household level, given the proportionate price and wage changes predicted by the CGE model.

The above formulation of the problem of measuring welfare impacts allows utility and profit functions to vary between households at given prices. To try to explain the heterogeneity in measured welfare impacts, one can suppose instead that these functions vary with observed household characteristics. The indirect utility function becomes:

$$v_i(p_i^d, w_i, \pi_i) = v(p_i^d, w_i, \pi_i, x_{1i}) = \max[u(q_i^d, L_i, x_{1i}) \,|\, p_i^d q_i^d - w_i L_i = \pi_i] \qquad \text{(A4)}$$

where

$$\pi_i = \pi(p_i^s, p_i^d, w_i, x_{2i}) = \max[p_i^s f(z_i, L_i^o, x_{2i}) - p_i^d z_i - w_i L_i^o] \qquad \text{(A5)}$$

Note that this allows the characteristics that influence preferences over consumption (x_{1i}) to differ from those that influence the outputs from own-production activities (x_{2i}).

The gain from the price and wage changes induced by trade reform, as given by equation (A3), depends on the consumption, labour 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 income.

Generically, we can now write the welfare gain as:

$$g_i = g(p_i^d, p_i^s, w_i, x_{1i}, x_{2i}) =$$
$$\sum_{j=1}^{m}[p_{ij}^s q^s(p_i^d, p_i^s, w_i, x_{2i})\frac{dp_{ij}^s}{p_{ij}^s} - p_{ij}^d[q^d(p_i^d, w_i, \pi_i, x_{1i}) + z_{ij}(p_i^d, p_i^s, w_i, x_{2i})]\frac{dp_{ij}^d}{p_{ij}^d}] \quad \text{(A6)}$$
$$+ \sum_{k=1}^{n} w_k[L_{ik}(p_i^d, w_i, \pi_i, x_{1i}) - L_{ik}^o(p_i^d, p_i^s, w_i, x_{2i})]\frac{dw_k}{w_k})$$

Notice that equations (A4) and (A5) imply that the gain from reform is inherently non-separable, in that one cannot write it as a function solely of p_i^d, x_{1i} and π_i. This is because the gains also depend on production choices.

As a practical data constraint, the China application (in common with many others) did not include data on household-specific wages and prices. Further assumptions are called for to deal with this data problem. In explaining the variation across households in the predicted gains from trade reform it can be assumed 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 county-level dummy variables.

Under these assumptions, and linearizing (A6) with an additive innovation error term, one can write the following regression model for the gains:

$$g_i = \beta_1 x_{1i} + \beta_2 x_{2i} + \sum_k \gamma_k D_{ki} + \varepsilon_i \quad \text{(A7)}$$

where $D_{ki} = 1$ if household *i* lives in county *k* and $D_{ki} = 0$ otherwise and ε_i is the error term. This motivates the regressions reported in Table 5.

References

Barro, R. (2000). 'Inequality and Growth in a Panel of Countries'. *Journal of Economic* Growth, 5 (1): 5-32.

Benjamin, D., L. Brandt, and J. Giles (2003). 'The Evolution of Income Inequality in Rural China'. Toronto: University of Toronto. Mimeo.

Bourguignon, F., and C. Morisson (1990). 'Income Distribution, Development and Foreign Trade'. *European Economic Review*, 34 (6): 1113–32.

Bourguignon, F., A.-S. Robilliard, and S. Robinson (2003). 'Representative versus Real Households in the Macro-Economic Modeling of Inequality'. Working Paper 2003-05. Paris: DELTA.

Chen, S., and M. Ravallion (2004a). 'How Have the World's Poorest Fared since the Early 1980s?'. *World Bank Research Observer*, 19 (2): 141-70.

Chen, S., and M. Ravallion (2004b). 'Household Welfare Impacts of WTO Accession in China'. *World Bank Economic Review*, 18 (1): 29-58.

Chow, G. C. (2002). *China's Economic Transformation*. Oxford: Blackwell Publishers.

Cockburn, J. (2002). 'Trade Liberalization and Poverty in Nepal: A Computable General Equilibrium Micro Simulation Analysis'. Quebec: University of Laval.

Datt, G., and M. Ravallion (1998). 'Farm Productivity and Rural Poverty in India'. *Journal of Development Studies*, 34: 62-85.

Dollar, D. (1992). 'Outward-Oriented Developing Economies Really Do Grow More Rapidly: Evidence from 95 LDCs, 1976-1985'. *Economic Development and Cultural Change*, 40 (3): 523-44.

Dollar, D. (2004). 'Globalization, Poverty, and Inequality since 1980'. Policy Research Working Paper 3333. Washington, DC: World Bank.

Dollar, D., and A. Kraay (2002). 'Growth is Good for the Poor'. *Journal of Economic Growth*, 7 (3): 195-225. Reprinted in A. Shorrocks and R. van der Hoeven (eds), *Growth, Inequality, and Poverty* (2004). Oxford: Oxford University Press for UNU-WIDER.

Dollar, D., and A. Kraay (2004). 'Trade, Growth and Poverty'. *Economic Journal*, 114 (493): F22-49.

Doukkali, R. (2003). 'Etude de Effets de la Libéralisation des Céréales: Resultats des Simulaions à L'Aide d'un Modèle Equilibre Général Calculable'. Joint Report of the Ministry of Agriculture and the World Bank.

Easterly, W., and S. Fischer (2001). 'Inflation and the Poor'. *Journal of Money Credit and Banking*, 33 (2): 160-78.

Edwards, S. (1997). 'Trade Policy, Growth and Income Distribution'. *American Economic Review*, 87 (2): 205-10.

Edwards, S. (1998). 'Openness, Productivity and Growth: What Do we Really Know?'. *Economic Journal*, 108 (447): 383-98.

Fan, S. (1991). 'Effects of Technological Change and Institutional Reform on Growth in Chinese Agriculture'. *American Journal of Agricultural Economics*, 73: 266-75.

Foster, J., J. Greer, and E. Thorbecke (1984). 'A Class of Decomposable Poverty Measures'. *Econometrica*, 52 (3): 761-5.

Guo, Jiann-Jong (1992). *Price Reform in China, 1979-1986.* New York: St. Martin's Press.

Harrison, A. (1996). 'Openness and Growth: A Time-Series, Cross-Country Analysis for Developing Countries'. *Journal of Development Economics*, 48 (2): 419-47.

Hertel, T. (ed.) (1997). *Global Trade Analysis: Modeling and Applications*. Cambridge: Cambridge University Press.

Hertel, T. W., and J. Reimer (2004). 'Predicting the Poverty Impacts of Trade Liberalization: A Survey'.Lafayette, IN: Dept. of Agricultural Economics, Purdue University.

Ianchovichina, E., and W. Martin (2004). 'Impacts of China's Accession to the WTO'. *World Bank Economic Review*, 18 (1): 3-28.

Li, H., L. Squire, and Heng-fu Zou (1998). 'Explaining International and Intertemporal Variations in Income Inequality'. *Economic Journal*, 108 (446): 26-43.

Lin, J. (1992). 'Rural Reforms and Agricultural Growth in China'. *American Economic Review*, 82 (1): 34-51.

Lundberg, M., and L. Squire (2003). 'The Simultaneous Evolution of Growth and Inequality'. *Economic Journal*, 113 (487): 326-44.

McCulloch, N., L. A. Winters, and X. Cirera (2001). *Trade Liberalization and Poverty: A Handbook*. London: Centre for Economic Policy Research and Department for International Development.

Milanovic, B. (2004). 'Can We Discern the Effect of Globalization on Income Distribution?'. *World Bank Economic Review*, forthcoming.

NBS (China National Bureau of Statistics) (2000). *China Statistical Yearbook*. Beijing: NBS.

Porto, G. (2004). 'On the Impacts of Agricultural Price Reforms: Joint Estimation of Demand and Wage Elasticities from Survey Data'. Washington, DC: Development Research Group, World Bank.

Ravallion, M. (2001). 'Growth, Inequality and Poverty: Looking Beyond Averages'. *World Development*, 29 (11): 1803-15.

Ravallion, M., and S. Chen (2004). 'China's (Uneven) Progress Against Poverty'. Policy Research Working Paper 3408. Washington, DC: World Bank. Available at: www//econ.worldbank.org/files/38741_wps3408.pdf.

Ravallion, M., and M. Lokshin (2004). 'Gainers and Losers from Agricultural Trade Reform in Morocco'. Policy Research Working Paper 3368. Washington, DC: World Bank. Available at: www //econ.worldbank.org/files/37704_wps3368.pdf

Ravallion, M., and D. van de Walle (1991). 'The Impact of Food Pricing Reforms on Poverty: A Demand Consistent Welfare Analysis for Indonesia'. *Journal of Policy Modeling*, 13: 281-300.

Rodriguez, F., and D. Rodrik (2001). 'Trade Policy and Economic Growth: A Sceptic's Guide to the Cross-National Evidence'. *NBER Macroeconomic Annual 2000*. Cambridge: MIT Press, 261-324.

Sachs, J., and A. Warner (1995). 'Economic Convergence and Economic Policies'. *Brookings Papers on Economic Activity*, 1: 1-95.

Sala-I-Martin, X., G. Doppelhofer, and R. Miller (2004). 'Determinants of Long- Term Growth: A Bayesian Averaging of Classical Estimates (BACE) Approach'. *American Economic Review*, 94 (4): 813-36.

UNCTAD (United Nations Conference on Trade and Development) (1994). *Directors of Import Regimes: Part 1: Monitoring Import Regimes*. Geneva: UNCTAD.

Winters, L. A., N. McCulloch, and A. McKay (2004). 'Trade Liberalization and Poverty: The Evidence So Far'. *Journal of Economic Literature*, 42 (March): 72-115.

World Bank (1997). *China 2020: Sharing Rising Income*. Washington, DC: World Bank.

World Bank (2000). *World Development Report: Attacking Poverty*. New York: Oxford University Press.

World Bank (2002). *Globalization, Growth and Poverty*. Washington, DC: World Bank.

World Bank (2003). Kingdom of Morocco: Findings and Recommendations of the Cereals Working Group: A Critical Review. Washington, DC: World Bank.

World Bank (2004). *World Development Indicators*. Washington DC: World Bank.