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The Making of Pro-poor Growth

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1 Introduction

On average, economic growth reduces poverty, and there is a voluminous body of empirical research to support this statement. However, the dispersion around the average is large: the elasticity of poverty with respect to economic growth varies considerably across countries and over time. The challenge for development economists and policymakers is to understand to what extent economic policies contribute to making growth more or less pro-poor.[1] This paper takes up the challenge from a macroeconometric perspective: using a relatively large sample of countries, a system of three endogenous equations is estimated in order to disentangle the different channels through which economic policy variables affect poverty dynamics. The specific policy variables that are investigated are meant to capture some of the key dimensions of the economic policy space of

[1] For the purpose of this paper, saying that growth is more or less pro-poor is equivalent to saying that poverty is more or less responsive to economic growth. Responsiveness is in turn associated with a notion of elasticity. Letting Δy and Δp denote the percentage change in per-capita income and poverty headcount respectively, the marginal effect of Δy on Δp gives a measure of the responsiveness of poverty to growth.

developing countries: openness to international trade, macroeconomic stability, depth of financial intermediation, size of government, and education.

There is a fast growing literature on the relationship between growth and poverty. Evidence of a significant poverty-reducing effect of economic growth goes back to Fields (1989) and Squire (1993), who estimate income elasticities of poverty reduction well in excess of two. Similar findings have been reported by Bruno et al. (1998) and Adams (2004). In a seminal paper, Dollar and Kraay (2002) show that the elasticity of mean income of the poor with respect to average mean income is not significantly different from one, meaning that growth is unambiguously good for the poor. Kraay (2006) provides additional evidence that most of the cross-country variation in poverty changes is due to the variation in the rate of average incomes growth. Ravaillon (1997, 2001 and 2004), Bourguignon (2003), Epualard (2003), Kawkani et al. (2004), Mosley et al. (2004), Kalwij and Verschoor (2007) stress that the growth elasticity of poverty significantly differ across countries and that these differences are largely explained by the interaction between growth and income inequality. In a recent contribution, Loyaza and Raddatz (2009) take a complementary perspective and show that the sectoral composition of growth affects its capacity to reduce poverty.

This paper extends the existing literature by exploring the role of economic policies in shaping the growth-inequality-poverty relationship. The theoretical prior of the paper is that economic policies can affect poverty in three separate ways: (i) by determining the rate of economic growth, (ii) by determining the dynamics of income inequality, and (iii) by determining the responsiveness of poverty to growth for any given rate of growth and change in inequality. These three channels are jointly estimated by using a system of three endogenous equations. The paper is therefore related to the work of Lundberg and Squire (2003) and Huang et al. (2009) on the simultaneous evolution of growth and inequality, although the addition of a poverty equation represents a significant innovation relative to previous studies. The use of a system of equations also makes the paper quite different from the analysis of Chhibber and Nayyar (2008), who go about exploring the impact of economic variables on the growth elasticity of poverty within a single equation framework.

The key findings of this paper can be summarized as follows. First, growth and redistribution reduce poverty. However, the growth elasticity of poverty is not affected by changes in income inequality. Second, there is no trade-off between growth and redistribution. In fact, the two processes seem to reinforce each other. Third, there is strong evidence of a feedback effect of poverty on both growth and inequality: an increase in the poverty headcount causes both a slowdown in growth and an increase in inequality. Fourth, economic policies determine poverty dynamics through multiple channels. Financial development and bigger government size contribute to poverty reduction via a positive effect on growth. This contribution is however offset, at least to some extent, by a contemporaneous inequality-increasing effect. Furthermore, financial development also appears to reduce the responsiveness of poverty to growth. Macroeconomic stabilization (here represented by a lower rate of inflation) promotes poverty re-

duction in two ways: by fostering growth and by making poverty more pro-poor. The role of trade openness and education appears to be limited to their effect on the responsiveness of poverty to growth. More specifically, an increase in trade openness makes poverty less responsive to growth while the opposite is true for education. Taking stock of these results, one can conclude that countries tend to move towards one of two possible equilibria. The positive (virtuous) equilibrium is characterised by faster growth, redistribution, and rapid poverty reduction. The negative (vicious) equilibrium involves slow (or even negative) growth, sharpening inequalities, and resilient poverty. The policy mix is then critical in determining to which of the two equilibria the country will converge.

The rest of the paper is organized as follows. Section 2 presents the data and some preliminary stylized facts. Section 3 introduces the econometric model and the estimation methodology. Results are reported in Section 4. Section 5 discusses the role of growth volatility in explaining why some economic policies make growth less pro-poor. Section 6 draws some policy conclusions. The description of the variables and the full list of countries/periods included in the dataset are provided in the Appendix.

2 Data and stylized facts

The source of poverty data is the PovcalNet Poverty Analysis Tool of the World Bank (www.http://iresearch.worldbank.org/PovcalNet/jsp/index.jsp). Let the sequence (t_n) denote the years when the data on a poverty indicator p are available for a generic country i. The dataset used in this paper consists of observations taken over spells determined from the sequence (t_n). Thus, for country i, the first spell starts at t_1 and ends at t_2; the second spell starts at t_2 and ends at t_3; and so forth until all data points are exhausted. The only additional restriction is that the minimum duration of a spell must be five years. In this way it is possible to filter out short-term dynamics and focus on long-term effects. In total, after the exclusion of some outliers, 151 spells, covering 83 countries, are identified. All the variables, with the exception of a set of country-fixed effects (see below), are expressed as annualized percentage changes over each spell. In addition, the dataset includes the initial values of all variables at the beginning of each spell plus their lagged annualized percentage change over the five years prior to the beginning of the spell. Initial and lagged values turn out to be useful instruments in the estimation process.

The poverty indicator used as a reference is the poverty headcount at 1 dollar per-day ($ph\_\$1$). Income is measured by per-capita GDP at constant prices and its annualized percentage change is of course the rate of economic growth (y_pc). Inequality is proxied by the *Gini coefficient* ($gini$), so that a negative percentage change in $gini$ corresponds to redistribution. The policy variables are as follows: (i) imports plus exports in percent of GDP to measure openness to international trade ($trade$), (ii) domestic credit to the private sector in percent of GDP to proxy for domestic financial depth ($credit$), (iii) the consumer price index (cpi) to capture macroeconomic stability, (iv) government expenditure in percent of

GDP (*gov)* to measure the size of the government, and (v) the average number of years of schooling in the population (*tyr*) to proxy for the accumulation of human capital. Finally, the country-fixed effects are: distance from the equator (*lat_abst*), French legal origins (*legor_fr*), and ethnic fragmentation (*ethnic*). As discussed below, these country fixed effects will be used in some equations to account for the role of institutional quality.

Table 1 reports some key summary statistics for *ph_$1, y_pc,* and the ratio of *ph_$1* to *y_pc*. Given that the variables are expressed as annualized percentage changes, their ratio can be effectively interpreted as the growth elasticity of poverty. Two sets of summary statistics are provided: one for the full sample of 151 spells and one for a restricted sample of 71 spells that are associated with a negative change in the Gini coefficient (that is $gini < 0$).

INSERT TABLE 1 ABOUT HERE

The average change in poverty is negative, but significantly more so when the sample is restricted to spells with decreasing inequality. The difference in the average value of the growth elasticity of poverty between the full and the restricted sample is however small. Therefore, redistribution appears to alleviate poverty directly rather than by conditioning the responsiveness of *ph_$1* to growth. The rate of economic growth is on average positive and slightly higher in the restricted sample, thus suggesting that redistribution and growth are not necessarily two mutually exclusive processes. The standard deviations of both *ph_$1* and *ph_$1/y_pc* are quite large. This wide dispersion around the averages is what motivates the study of the determinants of cross-country variation in the reposnsiveness of poverty to growth. Another interesting characteristic of *ph_$1* and *ph_$1/y_pc* is that they occasionally display very large values (as the maximum and minimum statistics indicate). These large values tend to occur in association with initially low values of the poverty headcount. In this sense, there seems to be a mild positive correlation between the initial level of the poverty indicator and the absolute value of the elasticity. Finally, while the growth elasticity of poverty is negative on average, in 49 spells out of 151 it is actually positive. These are all spells where inequality and per-capita income change in the same direction, but the change in inequality is so large that it more than offsets the effect of growth.

To uncover some empirical regularities in the data, table 2 reports a few basic correlations. The coefficients shown in the table are obtained from simple OLS regressions and hence they are not necessarily indicative of the direction of causality.

INSERT TABLE 2 ABOUT HERE

The coefficients in columns I and II indicate that there is a positive association between poverty reduction and growth and between poverty reduction and redistribution. However, the lack of significance of the coefficients in columns III and IV suggests that: (i) the relationship between growth and poverty reduction is linear (i.e. the absolute value of the growth elasticity of poverty

does not increase as the rate of growth increases) and (ii) the responsiveness of poverty to growth is not necessarily affected by the interaction between growth and redistribution. The coefficients in the last two columns indicate that there is no trade-off between growth and redistribution. In fact, both the inequality elasticity of growth and the growth elasticity of inequality are negative. This is certainly good news given that both growth and redistribution seem to contribute to poverty reduction.

3 Econometric model

Mathematically, a change in poverty is the combination of a change in average per-capita income and a change in the distribution of incomes around the average. Following Bourguignon (2003)[2], let z denote the poverty line drawn at 1 dollar per-day and $F(y)$ the cumulative distribution function of per-capita income in a given country. The poverty headcount at time t is therefore defined as $p_t = F_t(z)$. The change in the poverty headcount between t and $t+n$ is then given by $\Delta p = F_{t+1}(z) - F_t(z)$. Let then $G(\cdot)$ denote the distribution of income after normalizing for average income y_m. Any change in $F(\cdot)$ is the algebirc sum of (i) a change in $G(\cdot)$, holding y_m constant and (ii) a change in y_m that leaves $G(\cdot)$ unchanged. The change in $G(\cdot)$ is the "distribution component" of Δp and the change in y_m is the "growth component".

The above decomposition suggests that economic policies affect poverty via their contribution to changes in y_m (i.e. their contribution to economic growth) and $G(\cdot)$ (i.e. their contribution to redistribution). In addition, economic policies might shape poverty dynamics by making poverty more or less responsive to a given change in y_m for any given change in $G(\cdot)$. The theoretical rationale underlying this additional effect draws on the work of Vinod et al. (2000) on the *quality* of growth. The quality content of growth depends on the change in the value of assets like human and social capital and on the stability the growth process. For any given change in inequality, the decrease in poverty associated with a given rate of growth is likely to be higher the better the quality of this growth. Therefore, to the extent that they are able to promote better (or worse) quality of growth, economic policies will strengthen (or weaken) the responsiveness of poverty to growth.[3]

All in all, the effects of policies on poverty are transmitted via: (i) economic growth, (ii) changes in inequality, and (iii) changes in the responsiveness of poverty to growth. Accordingly, the econometric model consists of three endogenous equations:

$$y\_pc_s = \alpha_0 + \alpha_1 gini_s + \alpha_2 ph\_\$1_s + A_3 V_s + A_4 W_s + \varepsilon_s \qquad (1)$$

[2] See also Datt and Ravaillon (1992), Kakwani (1993), and Kraay (2006)

[3] Section 5 shows that most of the effect of policies on the responsiveness of poverty to growth is explained by their effect on the volatility of the growth process.

$$gini_s = \beta_0 + \beta_1 y\_pc_s + \beta_2 ph\_\$1_s + B_3 V_s + B_4 Z_s + \upsilon_s \quad (2)$$

$$ph\_\$1_s = \gamma_0 + \gamma_1 y\_pc_s + \gamma_2 gini_s + \gamma_3 gini_s * y\_pc_s + C_3(y\_pc_s * V_s) + \omega_s \quad (3)$$

where $y\_pc, gini, ph\_\$1$ are the annualized percentage changes in per-capita income, Gini index, and poverty headcount respectively, $\varepsilon, \upsilon, \omega$ are the error terms, and s indicates the generic spell in the dataset. V is a vector that includes the economic policy variables $tyr, credit, trade, cpi$,and gov (all expressed in annualized percentage changes). W is a vector of controls that includes the values of per-capita income and Gini coefficient at the beginning of each spell. Initial per-capita income (i_y_pc) is meant to account for conditional convergence effects while the initial value of the Gini index (i_Gini) captures the effect of given levels of inequality on subsequent growth dynamics. Z is a vector that includes the initial value of the Gini index (i_gini) and the country fixed effects $legor\_fr, lat\_bast$,and $ethnic$. The logic underlying the inclusion of these country fixed effects draws on Carmignani (2009): they represent structural determinants of institutional quality that are important in shaping the distribution of income over time. Finally, the parameters to be estimated are $\alpha_0, \alpha_1, \alpha_2, \beta_0, \beta_1, \beta_2, \gamma_0, \gamma_1, \gamma_2, \gamma_3$ plus the vector of coefficients A_3, A_4, B_3, B_4,and C_3.

Two main features of the above specification are worth a mention. First, the system formalizes the three transmission channels of the effect of policies on poverty dynamics: A_3 captures the effect via growth, B_3 the effect via changes in inequality, and C_3 the effect via the responsiveness of poverty to growth. Note that in equation (3), $y\_pc_s * V_s$ is in fact a vector of interactive terms between growth and the policy variables, so that the coefficients C_3 measure the contribution of policy variables to the partial derivative of $ph\_\$1$ w.r.t. y_pc. Because γ_1 is going to be negative, a positive coefficient on the interactive term means that higher values of the policy variable reduce the responsiveness of poverty to growth. A similar interpretation holds for the coefficient on the interactive term $gini_s * y\_pc_s$: if $\gamma_3 > 0$, the an increase in inequality lowers the responsiveness of poverty to growth. The second important feature of the system is that it allows for endogenous relationships between growth, changes in poverty, and changes in inequality as each of these three variables appears on the r.h.s. of the regression of the other two variables. In other words, the system incorporates the endogenous evolution of growth and changes in inequality (slope coefficients α_1 and β_1), the direct effects of growth and changes in inequality on poverty (slope coefficients γ_1 and γ_2), and the feedback effect of poverty dynamics on growth and changes in inequality (slope coefficients α_2 and β_2). The reason why this feedback effect might be important is that the poor are most likely to be socially excluded and economically marginalized from the rest of the society. As a consequence, an increase in poverty is expected to result in larger income inequalities and a smaller growth potential.

The system is estimated using a GMM system estimator (Wooldridge, 2003). The system estimator accounts for cross-correlations among the error terms of the three equations. At the same time, the system estimator is not immune from problems. In particular, if one of the three equations were misspecified, then the estimates of all the equations would be negatively affected. It is therefore wise to use equation-by-equation estimates to test the robustness of system estimates. The GMM system estimates will be then accompanied by a set of 2SLS estimates of each equation taken separately from the others. These equation-by-equation estimates are also useful to generate first stage diagnostics on the validity of the instruments chosen for the policy variables (see below).

A complication arising in the estimation of the system of equations (1), (2), and (3) is that the changes in the economic policy variables are likely to be endogenous to the dependent variables. For this reason, the economic policy variables (and the interactive terms in equation (3)) have to be instrumented. To this purpose, the time dimension of the dataset is exploited and lagged and initial values of all the potentially endogenous variables are used as instruments. In the case of interactive terms, the lagged and initial values are obtained from the interaction of the lagged and initial values of the individual terms. Country fixed effects and initial values of per-capita income and inequality are taken to be pre-determined and hence they are instrumented by themselves. This choice of instruments is then submitted to a battery of tests. To test the exogeneity of instruments, the Sargan test of overidentifying restrictions is used. The null hypothesis that the overidentifying restrictions implied by the choice of instruments are valid is never rejected at usual confidence levels. The relevance of instruments is assessed using first stage diagnostics from the equation-by-equation estimation. The standard partial R^2 is in the range of 0.5 to 0.7 and the p-value of the F-test of joint significance of the excluded instruments is always below 0.1. The Shea's partial R^2 is slightly lower than the standard partial R^2, but still in the range of 0.4 to 0.6. As discussed in Baum et al. (2003 and 2007), these values indicate that the chosen instruments are indeed relevant. All in all, the tests seem to suggest that the instruments are valid.[4]

4 Results

4.1 System estimates

System estimates are presented in Table 3. Column I reports the estimates of the growth equation (1), column II the estimates of the inequality equation (2), and column III the estimates of the poverty equation (3).

INSERT TABLE 3 ABOUT HERE

[4] The Sargan statistics and the associated p-values are reported at the bottom of the tables in the next section. The first stage diagnostics for each endogenous regressor can instead be obtained from the author upon request.

To start with, consider the endogenous relationship between growth, changes in inequality, and changes in poverty. The negative coefficient on y_pc and the positive coefficient on *gini* in column III imply that a combination of growth and redistribution provides the most favorable scenario for poverty reduction. At the same time, there is no evidence of a trade-off between growth and redistribution. In fact, the negative coefficients on *gini* in column I and on y_pc in column II indicate that redistribution favors growth and vice-versa. Interestingly, however, the lack of significance of the coefficient on the interactive term $y\_pc * gini$ in column III suggests that the change in inequality does not affect the growth elasticity of poverty. Finally, changes in poverty significantly feed back onto growth prospects and inequality dynamics. The signs of the coefficients on $ph\_\$1$ in columns I and II confirm the simple intuition that an increase in the poverty headcount reduces growth and increases inequality.

Turning to the effect of policy variables, the evidence is that multiple channels operate at the same time. For government size and financial intermediation two effects of opposite sign seem to be at work. On the one hand, both *gov* and *credit* contribute to poverty reduction by strengthening growth (column I). On the other hand, both variables also cause larger inequalities (column II). Moreover, the positive coefficient on $y\_pc * credit$ in column III implies that credit deepening reduces the responsiveness of poverty to economic growth. Macroeconomic stability (here identified by negative - or marginally positive - changes in the consumer price index) reduces poverty in two complementary ways: (i) by strengthening growth and (ii) by increasing the growth elasticity of poverty. Trade openness and education do not seem to produce any significant growth or redistribution effect. However, they affect poverty via their effect on its elasticity with respect to growth. More specifically, greater openness to trade makes poverty less responsive to growth, while wider eduction increases responsiveness.

Some of the above findings deserve a more explicit interpretation. The inequality-increasing effect associated with *gov* indicates that broad government expenditure is not well targeted to the poor. Hence, narrower and better targeted spending programs are required to reduce inequalities in developing countries. With respect to *credit*, one would probably expect deeper credit to reduce inequalities. However, in most developing economies, the rich have preferential access to credit. Therefore, an increase in the volume of credit might well widen the distance between rich and poor. Finally, the coefficients on the interactive terms between growth and policies in equation (3) are consistent with the view that policies make poverty more or less responsive to growth by affecting the quality of growth. Education is expected to improve the quality of growth by increasing the value of human and social capital. On the contrary, trade openness, macroeconomic instability, and financial deepening are likely to reduce quality of growth by making growth itself more volatile (see (5). The estimated coefficients then confirm that education makes growth more pro-poor while openness, macroeconomic instability, and financial deepening make growth less pro-poor.

The last bits of evidence concern the role of the other control variables in the growth equation (column I) and inequality equation (column II). In the growth

equation, there is no evidence of conditional convergence. In fact, the positive coefficient on i_y_pc suggests that initially richer countries tend to grow faster. The estimated coefficient on the initial level of inequality (i_gini) is instead negative, meaning that initially more unequal societies tend to experience slower growth. Note however that these societies do not necessarily fall into a poverty trap given that they can still undertake redistribution. Redistribution would then allow them to strengthen growth and reduce poverty at the same time. In the inequality equation, French legal origins and proximity to the equator tend to make the distribution less equal. The interpretation of this finding follows from la Porta et al. (1999). French legal origins and proximity to the equator tend to generate worse institutions. Bad institutions then sharpen income inequality (Carmignani, 2009). Finally, a higher initial inequality makes redistribution more difficult, possibly through some hysteresis effect. Combined with the evidence on the effect of i_gini from the growth equation, this result indicate that the progress in curbing inequalities and poverty might be initially slower in countries characterized by a high Gini coefficient. However, once initial gains are made, the process will be self-fulfilling.

4.2 Single equation estimates and robustness checks

As discussed in Section (3), it is important to check whether results are sensitive to the use of a system estimator vs. an equation-by-equation estimator. To this purpose, two stages least squares estimates of the three equations are reported in Table 4. The information in Table 4 is organized in the same way as in Table 3. The only addition is the R^2 of each equation to have an idea of the goodness of fit. It is immediately clear that the main results obtained from the system estimates are confirmed. Most of the variables retain their sign and significance. Only two notable exceptions emerge, both in the inequality equation. First, the feedback effect of changes in poverty on changes in inequality is no longer significant at usual confidence levels. Second, education now plays a perverse role as it increases inequalities.[5] Because the sign on the interactive term $y\_pc* tyr$ is still negative and significant, one can argue that wider education reduces absolute poverty while increasing relative poverty. In other words, an increase in average years of schooling makes both the rich and poor better off, but the income opportunities of the rich increase proportionally more than the income opportunities of the poor.

INSERT TABLE 3 ABOUT HERE

To test the robustness of the system estimates, the following sensitivity checks are also conducted.[6] First, the interactive term $y\_pc * i\_gini$ is added to the specification of the poverty equation. The rationale for including this interactive term follows from the mathematical decomposition of changes in

[5] This result is not new in the literature, see for instance Carmignani (2009).

[6] These additional estimates are not reported as they do not imply any qualitative change in the main result of the paper. Nevertheless, they are available from the author upon request.

the poverty rate, when the assumption is made that the distribution of income is log-normal (see Bourguignon, 2003). The coefficient of this new interactive term is expected to be positive, meaning that the growth elasticity of poverty is lower the more unequal income distribution initially is. It turns out that $y\_pc * i\_gini$ is largely insignificant. All of the other coefficients of the system are qualitatively the same as those reported in Table 3. Second, the initial level of per-capita income i_y_pc is added to the inequality equation. Again, the estimated coefficient is largely insignificant, while nothing else in the system changes. To allow for possible non-linearities, a specification including both i_y_pc and $(i\_y\_pc)^2$ is also estimated, but neither of the two terms appear to be statistically significant. Third, the country fixed effect $legor\_fr$, lat_abst, and $ethnic$ are added to the specification of the growth equation. Neither of the three is statistically significant. At the same time, i_y_pc and i_gini in the same equation become insignificant. This might be a symptom of multicollinearity, as the three country fixed effects might actually determine income and inequality levels via their effect on institutional quality. When i_y_pc and i_gini are removed from the growth equation, then both $legor\_fr$ and $ethnic$ display a statistically significant negative coefficient. Again, this result can be interpreted as evidence of the adverse effect of bad institutions on growth.[7]

Finally, to maximize the number of observations in the sample, the variable tyr and the associated interactive term y_pc*tyr are dropped from the system. As a matter of fact, tyr is not available for all 151 spells of the original dataset, and that is why the number of observations per equation is only 90. When dropping tyr it is possible to estimate the system on 120 observations per equation, for a total of 360 system observations. Relative to the estimates in table 3, estimated coefficients retain their sign, but occasional changes in their level of statistical significance are observed. The effect of government expenditure on growth and inequality is no longer significant. However, gov_cons now affects poverty by reducing its responsiveness to growth. The effects of credit deepening on inequality and responsiveness also become statistically insignificant, so that in the end $credit$ only affects poverty via a positive growth-effect. Finally, the effect of macroeconomic stability on the responsiveness of poverty becomes insignificant, while its effect on growth remains positive and significant.[8]

[7] Ideally, one would like to add a direct measure of institutional quality to the system. To construct a proxy that matches the irregular frequency and length of the spells in this dataset, annual data on institutions would be needed over the period 1980-2005 for all (or most of) the developing countries in the sample. However, this type of data is hardly available. An interesting possibility that will deserve attention in future work is to use "contract intensive money" (Clague et al. 1999) to proxy for institutional quality. Being constructed from widely available money aggregate data, contract intensive money can be computed over spells of irregular frequency and length.

[8] The system without tyr and $tyr * y\_pc$ is also re-estimated on a sub-sample that excludes transition economies to make sure that results (particularly those concerning the endogenous relationship between growth and redistribution) are not driven by the dynamics of the transformation from plan to market. No major changes relative to the estimates in Table 2 are observed.

5 Discussion: policies and the volatility of growth

The previous section offers some intriguing evidence on the role of financial intermediation. The positive coefficient on *credit* in equation (1) means that financial deepening strengthens growth, and this is indeed a rather common result in the growth literature. However, the positive coefficient on the interactive term $credit * y\_pc$ in equation (3) means that financial deepening also makes poverty less responsive to growth. How could this latter finding be explained? This section puts forward the following explanation: (i) more volatile growth tends to be less pro-poor and (ii) financial deepening increases growth volatility. It will turn out that the volatility channel also explains why trade openness and inflation make poverty less responsive to growth.

Intuitively, volatility hurts the poor more than the rich as the poor generally have less means to cope with the adverse consequences of sharp cyclical fluctuations. For instance, the poor might have very limited access to consumption smoothing technologies or their jobs might be less secure in a cyclical downturn. It then follows that higher volatility makes poverty less elastic with respect to growth. An empirical test of this conjecture can be simply performed by adding the interaction between growth and volatility to the standard model in column II of Table 2. Letting *vol* denote the standard deviation of the annual growth rate over each spell, then the estimated coefficients in the extended standard model are as follows (p-values in brackets):

$$ph\_\$1 = \underset{(0.46)}{1.210} + \underset{(0.000)}{-2.767} * y\_pc + \underset{(0.000)}{2.414} * gini + \underset{(0.037)}{0.225} * (y\_pc * vol) \qquad (4)$$

The positive coefficient on the interactive term $y\_pc * vol$ implies that higher values of *vol* reduce the marginal effect of y_pc on $ph\_\$1$. The inclusion of *vol* not interacted with growth does not change the results (and *vol* alone turns out to be largely insignificant). There is thus evidence that more volatile growth tends to be less pro-poor. The implication is that economic policy variables that increase volatility will also reduce the growth elasticity of poverty.

The question is then whether or not financial deepening is positively associated with growth volatility. In fact, a more developed financial system should allow for better consumption smoothing, even though this does not necessarily mean that output fluctuations will also be smoother. Moreover, if the expansion of credit occurs in waves, then boom-bust cycles would generate both higher average growth and higher growth volatility. A volatility equation is then estimated and the results are as follows:

$$vol = \underset{(0.000)}{2.427} + \underset{(0.000)}{0.023} * credit + \underset{(0.000)}{0.043} * cpi + \underset{(0.016)}{0.031} * trade \qquad (5)$$

In addition to *credit*, the equation includes two other policy variables that are likely to affect volatility. The positive coefficient on *cpi* indicates that there is a positive association between macroeconomic instability and output volatility. The positive coefficient on *trade* instead suggests that more open economies are

probably more exposed to external shocks. The effect of *credit* on volatility is also positive, in line with the credit-cycles argument.[9]

Taken together, equations (4) and (5) tell an interesting story: higher inflation, greater trade openness, and credit deepening make growth less pro-poor because they tend to increase the volatility of growth. Thus, the volatility channel explains the positive estimated coefficients on the interactive terms $y\_pc * cpi, y\_pc * credit, y\_pc * trade$ reported in Tables 3 and 4. Also note that the lack of significance of gov_cons in the volatility equation (see 5) might explain why the interactive term $y\_pc * gov$ is not statistically significant in the system estimates. Finally, growth volatility does not seem to be the relevant channel to explain the effect of education on the responsiveness of poverty to growth. As discussed above, this effect is in fact better understood in terms of redistribution of opportunities and value human capital.

6 Policy analysis and conclusions

The paper employs a system of three endogenous equations to study the determinants of absolute poverty dynamics. A key feature of the system is that it allows economic policy variables to affect poverty via separate effects on (i) the rate of economic growth, (ii) the change in income inequality, and (iii) the responsiveness of poverty to any given rate of growth. The system also incorporates a feedback effect of poverty dynamics on growth and inequality. The main results can be summarized as follows. First, the elasticity of poverty is negative with respect to growth and positive with respect to changes in income inequality, meaning that a combination of growth and redistribution represents the most favorable scenario for poverty reduction. Importantly, there is no evidence of a trade-off between growth and redistribution. If anything, the two processes appear to reinforce each other. However, the growth elasticity of poverty is not significantly affected by changes in inequality. Second, the feedback effect of poverty on growth and inequality is significant: an increase in poverty slows growth down and sharpens income inequalities. Third, economic policy variables affect poverty in different ways through different channels. Higher government expenditure and deeper level of financial intermediation generate two effects of opposite sign: they strengthen growth, thus reducing poverty, but they also sharpen inequality. Macroeconomic stability also determines a positive growth effect, without however causing any adverse effect on inequality. Economic policy variables have also significant effects on the extent to which any given rate of growth is more or less pro-poor. Greater openness to international trade, higher inflation, and deeper financial intermediation tend to increase the volatility of output growth and in this way the contribute to making poverty less elastic

[9] The equation is estimated by two stages least squares. The Hausman test indicates that *cpi* is potentially endogenous and therefore it is instrumented by its lagged and initial values. When added to the volatility equation, both *gov* and *edu* turn out to be largely insignificant. The inclusion of the level of per-capita GDP does not qualitatively change the estimated coefficients on $credit, trade$, and *cpi*.

with respect to growth. On the contrary, wider education increases the value of human capital in the economy, improves income opportunities, and therefore makes poverty more responsive to growth.

From a policymaking perspective, the empirical results highlight the importance of choosing the appropriate policy mix to fight poverty. The endogenous links between growth, redistribution, and poverty reduction imply that there exist two possible equilibria to which countries can converge. In the virtuous equilibrium, a country achieves a scenario of fast growth and redistribution. These two processes strengthen each other and reduce poverty. In turn, lower poverty improves growth prospects and reduces inequalities. In the vicious equilibrium, the country is unable to achieve the growth and redistribution scenario and hence poverty is not significantly reduced. Persistently high poverty in turn depresses growth and causes large inequalities, thus making the achievement of the favorable scenario even less likely. The policy mix then plays a critical role in determining which of the two equilibria the country converges to. The evidence discussed in the previous sections provides some indications on how the ideal policy mix (that is, the policy mix leading to the virtuous cycle) ought to be designed:

- Low and stable inflation should be set as a priority in the macroeconomic policy framework of developing countries. However, the framework should also be flexible enough to provide policymakers with the policy space required to take a truly counter-cyclical policy stance. In fact, a counter-cyclical macroeconomic policy would reduce the volatility of output growth, thus contributing to making poverty more elastic with respect to growth. In this respect, low inflation should be established as a medium-term target, thus allowing actual inflation to overshoot (or undershoot) the target in the short term to respond to cyclical shocks. A counter-cyclical macroeconomic policy that reduces volatility will also maximize the contributions of domestic financial development and trade liberalization to poverty reduction.

- Government size should not be reduced as it can be an important driver of growth. However, the scope of the government must be adjusted in view of the need to promote the redistribution of incomes. Government consumption must be therefore better targeted towards the poor. In this sense, subsidies and transfers appear to be rather effective in lowering the Gini coefficient (see for instance Carmignani, 2009). Therefore, budgetary allocations to these categories of public expenditure should be increased.

- The public supply of education services should be increased as wider education makes growth more pro-poor. The government should make sure that the delivery of education translates into an effective improvement of opportunities for the poor. This in turn calls for greater focus on "quality" issues, such as the update of curricula, the formation of teachers in rural areas, and the supply of teaching and study material.

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Appendix

Variables description

Unless otherwise indicated, all of the variables are expressed in *annualized percentage changes*. WDI is the World Development Indicators Database of the World Bank, 2008 issue.

- *ph_$1*, poverty headcount: Proportion of population living on less than 1 dollar per day. Source: PovcalNet, World Bank.
- *y_pc*, per-capita income: real per-capita GDP at constant US dollars (base year 2000). Source: WDI.
- *gini*, Gini coefficient of inequality of income distribution. Source: PovcalNet, World Bank.
- *gov*, government size: total government expenditure in percent of GDP. Source: WDI.
- *credit*, financial depth: domestic credit to the private sector in percent of GDP. Source: WDI.
- *trade*, international trade openness: exports plus imports in percent of GDP. Source: WDI.
- *cpi*, consumer price index. Source: WDI.
- *edu*, education: number of years of schooling of the average individual in the population. Source: Barro and Lee (2004) and UNESCO.
- *legor_fr*, French legal origin: dummy variable taking value 1 if country's legal system originates from the French civil code. Source: La Porta et al. (1999). This variable is expressed in levels.
- *ethnix*, ethnic fragmentation: probability that two randomly selected individuals are not from the same ethnic group. Source: La Porta et al. (1999). This variable is expressed in levels.
- *lat_abst*, distance from equator. Source: La Porta et al. (1999). This variable is expressed in levels.
- *vol*, growth volatility: standard deviation of *y_pc* over a given spell. Source: WDI
- *i_y_pc*, real per-capita GDP at the beginning of a given spell. Source: WDI. This variable is expressed in log-levels.
- *i_gini*,Gini coefficient at the beginning of a given spell. Source: WDI. This variable is expressed in log-levels.

List of countries and spells in the dataset

Albania 97_02
Algeria 88_95
Argentina 86_92
Argetnina 92_98
Argentina 98_03
Armenia 96_01
Azerbaijan 95_01
Bangladesh 84_89
Bangladesh 89_96
Belarus 88_93
Belarus 93_98
Bolivia 91_97
Bolivia 97_02
Botswana 86_94
Brazil 81_87
Brazil 87_92
Brazil 92_97
Brazil 97_02
Bulgaria 88_93
Bulgaria 93_98
Bulgaria 98_03
Burundi 92_98
Cameroon 96_01
Chile 87_92
Chile 92_98
China 87_93
China 93_99
Colombia 81_88
Colombia 88_95
Colombia 95_00
Costa Rica 81_86
Costa Rica 86_93
Costa Rica 93_98
Cote d'Ivoire 85_93
Cote d'Ivoire 93_98
Crotia 88_98
Czech Rep. 88_93
Dominc. Rep. 86_92
Dominic. Rep. 92_00
Ecuador 87_94
Egypt 91_00
El Salvador 89_95
El Salvador 95_00
Estonia 88_93
Estonia 93_98
Estonia 98_03
Ethiopia 82_95
Ethiopia 95_00
Gambia 92_98
Georgia 96_01
Ghana 88_98
Guatemala 87_98
Guyana 93_98
Honduras 86_92
Honduras 92_98
Honduras 98_03
Hungary 87_93
Hungary 93_98
India 87_93
India 93_00
Indoneisa 87_93
Indonesia 93_98
Iran 86_94
Jamaica 88_93
Jamaica 93_99
Jordan 92_97
Jordan 97_03
Kazakhstan 88_93
Kazakhstan 93_01
Kenua 92_97
Kyrgyz Rep. 93_98
Kyrgyz Rep. 98_03
Lao 92_97
Lao 97_02
Latvia 88_93
Latvia 98_03
Lesotho 87_93
Lithuania 93_98
Lithuania 98_03
Macedonia 98_03
Madagascar 80_93
Madagascar 93_99
Malawi 98_04
Malaysia 84_89
Malaysia 89_95
Mali 89_94
Mali 94_01
Mauritania 87_03
Mauritania 93_00
Mexico 84_89
Mexico 89_95
Mexico 95_00
Moldova 92_97
Moldova 97_02
Mongolia 95_02
Morocco 85_91
Morocco 91_99
Nepal 85_96
Nepal 96_04
Nicaragua 93_98
Nigeria 86_93
Nigeria 93_03
Pakistan 87_93
Pakistan 93_99
Panama 89_95
Panama 95_00
Paraguay 90_95
Paraguay 95_02
Peru 86_94
Peru 94_00
Philippines 85_91
Philippines 91_97
Poland 89_96
Poland 96_02
Romania 89_94
Romania 94_00
Russia 94_00
Rwanda 85_00
Senegal 91_01
Slovak Rep. 88_96
Slovenia 87_93
Slovenia 93_98
South Africa 93_00
Sri Lanka 85_90
Sri Lanka 90_96
Sri Lanka 96_02
Tanzania 91_01
Thailand 81_88
Thailand 88_96
Thailand 96_02
Tunisia 85_90
Tunisia 90_95
Tunisia 95_00
Turkey 87_94
Turkey 94_00
Turkmenistan 93_98
Uganda 89_96
Uganda 96_02
Ukraine 88_95
Ukraine 95_02
Uruguay 81_89
Uruguay 89_96
Uzbekistan 93_98
Venezuela 81_87
Venezuela 87_93
Venezuela 93_98
Vietnam 93_98
Yemen 92_98
Zambia 91_96
Zambia 96_03
Zimbabwe 90_95

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Tables

Table 1: Summary statistics of poverty, growth, and elasticity

	$ph\_\$1$	y_pc	$\frac{ph\_\$1}{y\_pc}$
Full sample			
Mean	-1.24	1.32	-1.96
Median	-2.26	1.49	-0.94
Maximum	59.51	8.28	56.35
Minimum	-50.11	-11.39	-66.44
Standard deviation	19.04	3.33	13.80
Sample with $gini < 0$			
Mean	-6.99	1.72	-2.08
Median	-5.63	1.52	-1.67
Maximum	51.30	7.68	43.25
Minimum	-50.11	-3.01	-28.04
Standard deviation	14.85	2.55	9.70

Notes: The sample includes 151 spells covering 83 countries (see list in the Appendix). The variables are expressed as annualized percentage change over each spell.

Table 2: Correlations between poverty, growth, and elasticity

	I	II	III	IV	V	VI
	$ph\_\$1$	$ph\_\$1$	$\frac{ph\_\$1}{y\_pc}$	$\frac{ph\_\$1}{y\_pc}$	y_pc	$gini$
y_pc	-1.879***	-1.415***		0.089	..	-0.203***
$gini$	..	2.29***	-0.142	-0.116	-0.277***	..

Notes: The coefficients are obtained from an OLS regression of each dependent variable on the listed regressors. The constant term is always included, but not reported in the table *, **, ***denote statistical significance at the 10%, 5%, and 1% confidence level respectively.

Table 3: System estimates

	I	II	III
	y_pc	$gini$	$ph\_\$1$
$const$	13.518***	20.128***	-0.403
y_pc	..	-0.322***	-3.307***
$gini$	-0.450***	..	0.801**
$ph\_\$1$	-0.048***	0.018*	..
gov	0.088***	0.160***	..
cpi	-0.029***	-0.005	..
$trade$	0.019	0.017	..
$credit$	0.119***	0.044*	..
tyr	-0.013	0.012	..
i_y_pc	0.352***	..	..
i_gini	-3.720***	-5.130***	..
$legor\_fr$	..	0.823***	..
lat_abst	..	-1.184**	..
$ethnic$	..	-0.546	..
$y\_pc * gov$	..	..	0.119
$y\_pc * cpi$	..	..	0.057**
$y\_pc * trade$	..	..	0.458***
$y\_pc * credit$	..	..	0.191***
$y\_pc * tyr$	..	..	-0.568***
$y\_pc * gini$	..	..	-0.151
Observations		270	
Sargan test		50.49 (44 d.f.)	
p_value		0.232	

Notes: GMM system estimates of equations 123. $i\_y\_pc, i\_gini, legor\_fr, lat\_abst$, and $ethnic$ are exogenous. The set of instruments includes the exogenous variables plus lagged and initial values of all the other endogenous regressors. *, **, ***denote statistical significance at the 10%, 5%, and 1% confidence level respectively.

Table 4: Single equation estimates

	I	II	III
	y_pc	$gini$	$ph\_\$1$
$const$	19.218***	18.823***	0.164
y_pc	..	-0.187***	-3.685***
$gini$	-0.607***	..	0.808**
$ph\_\$1$	-0.041***	0.014	..
gov	0.088***	0.111***	..
cpi	-0.042***	-0.011	..
$trade$	-0.023	-0.004	..
$credit$	0.129***	0.008***	..
tyr	0.030	0.071**	..
i_y_pc	0.353***	..	..
i_gini	-5.174***	-4.824***	..
$legor\_fr$	..	0.826***	..
lat_abst	..	-1.604**	..
$ethnic$	..	-0.726	..
$y\_pc * gov$	..	..	0.144
$y\_pc * cpi$	..	..	0.057**
$y\_pc * trade$	..	..	0.453***
$y\_pc * credit$	..	..	0.196***
$y\_pc * tyr$	..	..	-0.460***
$y\_pc * gini$	..	..	0.014
Observations	90	90	90
Sargan test	15.98	13.29	20.29
p_value	0.383	0.425	0.207
R2	0.692	0.835	0.524

Notes: 2SLS system estimates of equations 123. $i\_y\_pc, i\_gini, legor\_fr, lat\_abst$, and $ethnic$ are exogenous. The set of instruments includes the exogenous variables plus lagged and initial values of all the other endogenous regressors. *, **, ***denote statistical significance at the 10%, 5%, and 1% confidence level respectively.