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Structural Policies for Shock-Prone Developing Countries*

Paul Collier† and Benedikt Goderis‡

Department of Economics, University of Oxford

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Abstract

Many developing countries periodically face large adverse shocks to their economies. We study two distinct types of such shocks - large declines in the price of a country's commodity exports and severe natural disasters - , both of which have occurred frequently in the recent past. Unsurprisingly, adverse shocks reduce the short-term growth of constant-price GDP and we analyze which structural policies help to minimize these losses. Structural policies are incentives and regulations that are maintained for long periods, contrasting with policy *responses* to shocks, the analysis of which has dominated the literature. We show that some previously neglected structural policies have large effects that are specific to particular types of shock. In particular, regulations which reduce the speed of firm exit substantially increase the short-term growth loss from adverse non-agricultural export price shocks and so are particularly ill-suited to mineral exporting economies. Natural disasters appear to be better accommodated by labour market policies, perhaps because such shocks directly dislocate the population.

Keywords: commodity price shocks; natural disasters; growth, policies

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† Centre for the Study of African Economies, Department of Economics, University of Oxford, Manor Road, Oxford OX1 3UQ, UK. Email: Paul.Collier@economics.ox.ac.uk.

‡ Department of Economics, University of Oxford, Manor Road, Oxford OX1 3UQ, UK. Email: Benedikt.Goderis@economics.ox.ac.uk.

1. Introduction

Global commodity prices are highly volatile and this makes commodity exporters shock-prone. The analysis of economic policies appropriate for such economies has focused predominantly upon government *responses* to windfalls: notably, how should it adjust public spending and the exchange rate? In contrast, our focus is upon *structural* policies, typically maintained for long periods, that affect the ability of private actors to respond to shocks through regulation. Rather than *windfalls* we consider adverse shocks. With the current sharp and unanticipated decline in commodity prices it is appropriate to consider the adoption of structural policies that might better enable the economies of commodity-exporting countries to cope.

In principle, it should be far easier for a government to get structural policies right than to get policy responses right. Response requires that a government be fleet of foot, and may also require it to make a correct assessment as to how the shock will evolve. In contrast, appropriate structural policies do not need to be adopted in haste: a government that recognizes that its economy is prone to shocks can gradually put in place such policies as precautionary and subsequent governments can maintain this legacy without further action.

In this paper we empirically investigate the role of structural policies in mitigating the growth loss from adverse shocks. In addition to commodity export price shocks, we also consider large natural disasters. Using data for around 130 countries from 1963 till 2003, we find that adverse commodity export price shocks and natural disasters matter substantially for short-term growth. We do not find evidence of a long run

effect of commodity export price shocks (volatility) on the level of GDP. We investigate the efficacy of a range of structural policies in mitigating the negative short-term growth effects from shocks. Our results show that regulations that delay the speed of firm closure significantly and substantially increase the short-term growth loss from adverse price shocks in commodity-exporting countries. In the case of natural disasters, on the other hand, the negative effect on short-term growth is increased by labour market regulations that prevent an efficient re-allocation of workers. Our results are robust to alternative specifications and shock measures, as well as the inclusion of an extensive range of control variables for other regulations, other policies and institutional quality.[4]

The paper is structured as follows. In Section 2 we discuss our methodology and our data. Section 3 presents our core results and Section 4 tests their robustness. Section 5 concludes.

2. Methodology and Data

Our estimation strategy involves two steps. We first test the effects of adverse shocks on growth. Having established their adverse effects, we then investigate the consequences of various structural policies in mitigating the losses.

Measuring Shocks

[4] This paper is related to the literature on terms-of-trade shocks and growth. Recent contributions include Raddatz (2007), Loayza and Raddatz (2007) and Broda (2004).

The first step is to construct a measure of adverse shocks. We consider two distinct types of shock: large declines in the price of a country's commodity exports, and severe natural disasters.

We use the commodity export price index[5] of Collier and Goderis (2008) to construct measures of commodity export price shocks. The index was constructed using the methodology of Deaton and Miller (1995) and Dehn (2000). We collected data on world commodity prices and commodity export values for as many commodities as data availability allowed. Table 1b lists the 50 commodities in our sample. For each country we calculate the total 1990 value of commodity exports. We construct weights by dividing the individual 1990 export values for each commodity by this total. These 1990 weights are then held fixed over time and applied to the world price indices of the same commodities to form a country-specific geometrically weighted index of commodity export prices. This index was first constructed on a quarterly basis and deflated by the export unit value. We then calculate the annual average of the quarterly index (rescaled so that 1980 = 100), which yields an annual commodity export price index. Below, we will use this annual index to construct measures of commodity export price shocks and commodity export price volatility.

We first construct measures of commodity export price shocks. We define shocks as episodes with large changes in commodity export prices. In our core results we follow Collier and Dehn (2001) in removing the predictable component of shocks. Specifically, we take the first difference of the log of the annual commodity export

[5] See Collier and Goderis (2008) for data description and sources.

price index and then remove its predictable component by running the following forecasting estimation model:

$$\Delta I_{i,t} = \alpha_0 + \alpha_1 t + \beta_1 \Delta I_{i,t-1} + \beta_2 I_{i,t-2} + \varepsilon_{i,t} \tag{1}$$

where $I_{i,t}$ is the log annual commodity export price index and t is a linear time trend. We collect the residuals $\varepsilon_{i,t}$ from equation (1) and calculate the 10th and 90th percentile of their distribution. However, our results are not dependent upon the exclusion of the predictable component. Indeed, the extreme shocks on which we focus are virtually unpredictable from past price information so that any such adjustment makes only a negligible difference. Positive and negative commodity export price shock episodes are defined as the observations with residuals above the 90th or below the 10th percentile, respectively. For robustness we will also estimate the effect of shocks using the 5th and 95th percentile as thresholds. Having identified the shock episodes, we next construct two variables. The first captures *positive* commodity export price shocks and equals the first log difference of the annual commodity export price index for the *positive* shock episodes, and zero otherwise. The second captures *negative* commodity export price shocks and equals minus the first log difference of the annual commodity export price index for the negative shock episodes, and zero otherwise. Finally, to allow the effect of commodity export price shocks to be larger for countries with larger exports, we weight the two variables by the share of commodity exports in GDP. Our estimation sample contains 377 positive shock episodes and 392 negative shock episodes. We will use the constructed measures to test the effect of commodity export price shocks on short run growth.

In addition to any effect of shocks on short run growth, changes in commodity export prices may also have an effect on growth in the long run. To allow for this possibility, we also include a measure of export price *volatility*. In particular, we construct a variable that captures the pre-1986 mean absolute change in the log of the annual commodity export price index for the years before 1986 and the post-1985 mean absolute change in the log of the annual commodity export price index for the years after 1985. We then weight this variable by the share of commodity exports in GDP to allow the effect of volatility to be proportional to a country's exposure. This yields a weighted measure of commodity export price volatility, which we will use to estimate the effect of commodity export price volatility on the long run level of GDP. For sensitivity, we constructed an alternative measure of volatility. In particular, we use the quarterly deflated commodity export price index[6] and for each quarter calculate the country-specific standard deviation of this index over the quarter and the three preceding quarters. This yields a country-specific rolling standard deviation of commodity export prices. We then use the log of the annual average of this variable, weighted by the share of commodity exports in GDP, as an alternative measure of volatility.

As a final commodity export price measure, we use the log of the annual commodity export price index, weighted by the 1990 share of commodity exports in GDP, as a long run control variable. We also include an oil import price index, which was

[6] This is the quarterly index that we constructed prior to calculating its annual average to obtain the annual commodity export price index.

constructed by interacting the log of the annual average of a deflated quarterly world oil price index with a dummy variable for net oil importers.[7]

Our indicator of natural disasters[8] captures the total number of geological, climatic and human disasters in a year (Raddatz, 2007). We include only events that qualify as 'large' disasters according to the criteria established by the International Monetary Fund (2003).[9] Our estimation sample contains 688 episodes with one or more large natural disasters.

Effects of Shocks on Growth

We analyze the effects of shocks by estimating the error-correction model in equation (2) below.[10]

$$\Delta y_{i,t} = \alpha_i + \delta' z_{i,t} + \lambda y_{i,t\text{-}1} + \beta_1' x_{i,t\text{-}1} + \beta_2' l_{i,t\text{-}1} + \beta_3 \Delta y_{i,t\text{-}1} + \beta_4' \Delta x_{i,t\text{-}1} + \sum_{j=0}^{1} \beta_5' s_{i,t\text{-}j} + \sum_{j=0}^{1} \beta_6' p_{i,t\text{-}j}$$
$$+ \sum_{j=0}^{1} \sum_{q=1}^{k} \beta_{7q}' (s_{i,t\text{-}j})(p_{i,t\text{-}j,q}) + u_{i,t} \qquad (2)$$

where the subscripts $i = 1,\ldots N$ and $t = 1,\ldots T$ index the countries and years in the panel, respectively. $y_{i,t}$ is log real GDP per capita in constant 2000 US$ (World

[7] See Collier and Goderis (2008) for data description and sources.

[8] Data are from the WHO Collaborating Centre for Research on the Epidemiology of Disasters (CRED). Geological disasters: earthquakes, landslides, volcano eruptions, tidal waves; Climatic disasters: floods, droughts, extreme temperatures, wind storms; Human disasters: famines, epidemics.

[9] ≥ 0.5% of population affected or damage ≥ 0.5% of GDP or ≥ 1 death per 10000 (IMF, 2003).

[10] This model is based on Collier and Goderis (2008), who report panel unit root and cointegration tests.

Development Indicators (WDI)) in country i in year t, α_i is a country-specific fixed effect, and $z_{i,t}$ is an $rT \times 1$ vector of regional year dummies, where r is the number of regions.[11] $x_{i,t-1}$ is an $m \times 1$ vector of m variables that are expected to affect GDP in the long run and in the short run. We include three control variables from the empirical growth literature: trade openness, measured as the ratio of trade to GDP (WDI); inflation, measured as the log of 1 plus the annual consumer price inflation rate (WDI); and international reserves over GDP (International Financial Statistics (IFS) and WDI). $l_{i,t\text{-}1}$ is an $h \times 1$ vector of h variables that are expected to affect GDP in the long run only. We include the log of the annual commodity export price index, weighted by the 1990 share of commodity exports in GDP, as well as the oil import price index, to control for the long run effects of commodity export and oil import prices.[12] We also include our indicator of commodity export price volatility. The vector $s_{i,t-j}$ consists of n variables that are expected to have only a short-run effect on growth and includes our measures of commodity export price shocks and natural disasters.[13] We also include indicators that capture civil war (Gleditsch, 2004) and the number of coup d'etats[14].

[11] We include the following regions: Central and Eastern Europe and Central Asia, East Asia and Pacific and Oceania, Latin America and Caribbean, North Africa and Middle East, South Asia, Sub-Saharan Africa, and Western Europe and North-America.

[12] The short run effect of commodity export prices is captured by the shock variables (see below).

[13] The price shocks capture large changes in the commodity export price index. We did not find any significant effect of smaller price changes and therefore did not include the change in the index.

[14] A coup d'etat is defined as an extra constitutional or forced change in the government elite or its control of the nation's power structure ((Cross-National Time-Series Data Archive).

Our key interest is in the vector $p_{i,t-j}$ of k indicators of policies that could potentially mitigate the adverse growth effects of commodity export price shocks and natural disasters. Some of these structural policies are standard in the analysis of shocks, notably financial depth, financial openness, remittances and international reserves. The key contribution of this paper is to add indicators that capture the flexibility of labour markets and the flexibility of firm entry and exit, all based on the 'Doing Business' surveys of the World Bank. The interaction of $s_{i,t-j}$ and $p_{i,t-j}$ in equation (2) tests whether these structural policies mitigate the effects of shocks.[15]

Our dataset consists of all countries and years for which data are available, and covers around 130 countries between 1963 and 2003. Table 1a reports summary statistics for the variables used in estimation.

3. Estimation Results

Preliminaries

The results of estimating equation (2) are reported in Table 2. We first simply investigate whether shocks matter for growth, the interaction effects being introduced later.

[15] We only include shock-policy interactions for commodity export price shocks and natural disasters, not for wars and coups.

The coefficients for commodity export price shocks and natural disasters all have the expected signs. Negative price shocks lower growth[16], both in the same year and in the next, but the effect is much larger and is significant at 1 percent in the year after the shock.[17] The size of the coefficient suggests that for countries like Nigeria and Zambia, where commodity exports represent 35 percent of GDP, a negative price shock of 30 percent lowers growth in the next year by 0.358*0.35*0.30 = 3.8 percentage points. Positive price shocks have a positive effect on growth, but the effects are not significant. This asymmetry is not surprising. If the economy is normally close to its productive capacity then sudden large increases in export earnings cannot rapidly raise aggregate output. In contrast, sudden large decreases will reduce both export output and demand elsewhere in the economy, and these will rapidly lower aggregate output unless prices are highly flexible and resources swift to move. The coefficient for natural disasters is negative and significant at 5 percent. However, the effect on output of the typical natural disaster is modest, lowering growth by only 0.37 percentage points.[18]

While negative commodity export price shocks significantly lower growth in the short run, we do not find evidence of a long-run negative effect of commodity export price

[16] Since our dependent variable is the change in log *constant-price* GDP per capita, it is not directly affected by changes in export prices.

[17] We experimented with both additional lags and squared terms but they proved to be unimportant.

[18] In all tables, we multiply the coefficients for natural disasters by 10 to make them more informative (compare -0.037 with -0.004). The coefficient in Table 2 (-0.037) thus corresponds to a growth loss of 0.10 * 0.037 = 0.37 % points.

volatility on GDP. The indicator of volatility enters with the counterintuitive positive sign and the coefficient is far from significant.[19]

We next turn to the other variables in Table 2. The long-run coefficients for trade openness, inflation, and international reserves have the expected sign and are significant. The long-run effect of commodity export prices is negative and significant, which is consistent with the "resource curse" finding in Collier and Goderis (2008). The long run effect of higher oil prices on oil importing countries is negative but insignificant. The short-run adjustment coefficient is highly significant and suggests a speed of adjustment of around 6 percent per year. The other short-run coefficients all have the expected sign but are sometimes insignificant. The lagged dependent variable enters positive and significant at 1 percent, while coups and civil wars have unsurprisingly large adverse effects on growth.

Shocks and Policies

Having established that both negative commodity export price shocks and natural disasters have significant adverse growth effects, we now investigate alternative policies that could potentially mitigate these effects. We first considered financial depth, financial openness, international reserves and remittances but did not find any significant shock-mitigating effect of these policies.[20]

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[19] We tested the robustness of this result using our alternative measure of volatility. The long run coefficient was again positive and insignificant.

[20] To save space, we do not discuss these estimation results but they are available in an online supplementary document (see http://users.ox.ac.uk/~econpco/).

Governments control an array of policies that affect the functioning of labour markets. Because employment is politically sensitive, there is a wide range in the degree to which governments regulate labour markets, permitting flexibility. We might expect that the ability of economic actors to respond to shocks is influenced by regulatory restrictions on hiring and firing. In countries with more flexible labour markets, labour can more easily be reallocated from sectors or regions that are hit by the shock.

We investigate the importance of labour market flexibility using indices of employment flexibility that were calculated from data of the 'Doing Business' surveys of the World Bank (World Bank, 2007). The Doing Business project started in 2004 and provides measures of business regulations and their enforcement across 178 countries. Part of the project focuses on the regulation of employment and includes a composite index of 'rigidity of employment', which is the average of 3 sub-indices: a difficulty of hiring index, a rigidity of hours index, and a difficulty of firing index. All indices have ordinal scales. Our composite measure of employment flexibility is a dummy variable that takes a value of one for all years if a country's average value of the 'rigidity of employment' index between 2004 and 2007 in Doing Business is below its median value for all countries and zero if it is above its median value.

In addition to the regulation of employment, Doing Business also studies the regulation of firm exit and entry. This involves all procedures that entrepreneurs have to follow in order to close down or start up a business. Since the ability of an economy to reallocate capital and labour after a shock is likely to depend on the flexibility of entrepreneurs to close down businesses, we specifically investigate whether the flexibility of firm exit mitigates the adverse effects of shocks.

Our measure of speed of firm exit is based on the average 2004-2007 value of the variable 'time to close a business' in Doing Business, which we rescaled to range from 0 to 1, with higher values indicating a higher speed of firm exit.[21] The time to close a business is calculated for a limited liability company in the country's most populous city, which has a hotel as its major asset and employs 201 employees. It varies between 5 months and 10 years.

We first test whether employment flexibility and speed of firm exit mitigate the negative growth effects of adverse *commodity export price shocks*.[22] In Table 3, we add interactions of the indicators of each of these flexibility measures with each of the four commodity export price shocks to the specification of Table 2.[23] The lagged negative price shock again enters negative and the coefficient is significant at 1 percent, indicating that a country without shock cushioning policies suffers a significant growth loss. However, the interaction of the shock with our speed of firm exit indicator enters positive and is also significant at 1 percent, suggesting that countries with faster bankruptcy procedures suffer significantly less from export price shocks. The effect is big. For a country like Indonesia, with commodity exports of 15 percent over GDP, a relatively low speed of firm exit of 0.45 (5th percentile of the sample distribution) and a value of zero for the employment flexibility dummy, a

[21] In contrast to the ordinal indicators of labour market flexibility, the Doing Business indicator *'time to close a business'* has a cardinal scale. We therefore did not turn it into a dummy variable but instead constructed a continuous indicator of the speed of firm exit.

[22] The correlation between our indicators of employment flexibility and speed of firm exit is 0.11.

[23] We do not add the flexibility measures by themselves as they are time invariant and are therefore captured by the country fixed effects.

negative commodity export price shock of 30 percent lowers growth in the next year by around 2.71 percentage points. If Indonesia were to increase its speed of firm exit to the 95th percentile of the sample distribution (0.95), this growth loss would fall from 2.71 percentage points to 0.01 percentage points.[24] These results suggest that the speed of bankruptcy procedures is very important for the ability of countries to cope with adverse commodity export price shocks.

Although the procedures for closing a business will often extend beyond the growth impact of a shock, we might indeed expect the speed with which they can be completed to be important. One reason is that adverse shocks can lead to a severe reduction in lending. Such liquidity problems are much more likely to occur in countries with lengthy and disorderly bankruptcy procedures. If investors face years of litigation and uncertainty, they will be much less inclined to provide new loans and in the worst case a country's liquidity will fully dry up. A second potential transmission mechanism is that if the supply of entrepreneurship is limited, the inability of entrepreneurs to exit activities where business has deteriorated will slow the pace at which new opportunities are taken up.

The coefficient of the interaction of the lagged negative price shock with the employment flexibility indicator is virtually zero and highly insignificant, indicating

[24] It should be noted that our results suggest that if Indonesia were to increase its speed of firm exit to 1 (the highest possible level), the net effect of an adverse price shock would be just positive, which is counterintuitive. However, this effect is far from statistically significant (p-value = 0.73). Moreover, there is only one country in the estimation sample which has the highest possible speed of firm exit (Ireland). Given Ireland's low share of commodity exports in GDP (0.027), an adverse price shock of 30 percent is estimated to cause only a very marginal increase in Ireland's growth rate (0.05 % points).

that, in contrast to the flexibility of firm exit, labour market flexibility does not reduce the growth loss from adverse price shocks.[25] The coefficients of the other variables in Table 3 are similar to the coefficients in Table 2. Perhaps, as with financial depth, labour market flexibility might have offsetting effects, facilitating resource reallocation but amplifying the initial demand shock as workers lose their jobs.

Having established that the speed of firm exit mitigates the adverse effect of commodity export price shocks, we next investigate whether it also mitigates the adverse effect of natural disasters. In Table 4, we add interactions of the indicators of employment flexibility and speed of firm exit with the natural disaster variable to the specification of Table 2. The natural disaster variable by itself enters with a negative sign and is statistically significant at 5 percent, indicating that a country without shock cushioning policies suffers a significant growth loss. The coefficient of the interaction between the natural disaster variable and the speed of firm exit indicator is again positive but is statistically insignificant. Recall that natural disasters typically have far smaller adverse effects on output than do large export price shocks, so that the lack of significance may simply be because the interaction effect is too small to detect. This explanation is, however, qualified by the interaction between the natural disaster variable and the flexibility of employment indicator which enters positive and significant at 1 percent. Labour market flexibility cushions the effects of natural disasters and the effect is substantial. While the average natural disaster lowers growth by 1.35 percentage points in countries with no mitigating policies, this growth

[25] As part of our sensitivity analysis in section 4, we test the robustness of this finding using an alternative labour market flexibility indicator from the World Economic Forum's Global Competitiveness Report. We find the same result.

loss is only 0.22 percentage point in countries with a flexible labour market. There may therefore be a genuine difference between the effects of the policies on export shocks and natural disasters. Disasters are physical shocks that typically hit in rural areas, forcing the mass relocation of people. They may therefore place a relatively large burden on the labour market, with flexibility enabling people who have been relocated to find new employment. In contrast, since businesses are overwhelmingly urban, they may only be lightly affected by natural disasters, whereas export shocks are exclusively monetary and so inevitably hit them.

4. Sensitivity and Endogeneity

We now investigate the sensitivity of our results to alternative specifications. We first consider the robustness of our finding that speed of firm exit mitigates adverse export price shocks.

Adverse Commodity Export Price Shocks

As a first check, we re-estimate the specification of Table 3 without the interactions of the commodity price shocks with the indicator of employment flexibility. The results are reported in Table 5, column (1). To save space, we only report the coefficients and standard errors of the variables of interest.[26] The lagged adverse price shock again enters with a negative sign and remains significant at 1 percent. The interaction of the

[26] Full estimation results for the specifications in Tables 5 and 6 are available in an online supplementary document (see http://users.ox.ac.uk/~econpco/).

shock with speed of firm exit again enters positive and is significant at 5 percent. The size of both coefficients is almost identical to the size of the coefficients in Table 3.

A possible concern with these estimation results is that the explanatory variables are endogenous, i.e. correlated with the error term in equation (2). Endogeneity could potentially relate to the shocks, the policies, or both. Adverse commodity export price shocks may be endogenous to the extent that some exporters may have an influence over the world price of the commodities that they export. If the world prices are indeed affected by the actions of some large commodity exporters, the assumption of exogeneity may be violated. To address this concern, we express each country's exports of a given commodity as a share of the total world exports of that commodity and repeat this for all other commodities in our sample. This yields a list of commodity export shares that reflect the importance of individual exporters in the global markets for individual commodities. We found that of the 129 countries in our sample, 22 countries export at least one commodity for which their share in world exports exceeds 20 percent. We investigate whether the inclusion of these major exporters in our sample affected our results by re-estimating the specification in Table 5, column (1), but without these 22 countries. The results, available upon request from the authors, show that our findings are strongly robust to the exclusion of major exporters of individual commodities. In fact, the coefficients for the shock and the interaction of the shock with the speed of firm are almost unchanged (-1.17 and 1.19, respectively), while both coefficients are significant at the 5 percent level. This shows that our results are not affected by the large exporters in our sample and hence casts doubt on the hypothesis that the coefficient of the lagged price shock variable is

biased. More generally, it is difficult to see how a large decline in export prices could be induced by a *decline* in aggregate output in exporting countries.

Another possible source of endogeneity is the policy variables. If a country's speed of firm exit is correlated with other (omitted) structural characteristics or policies that mitigate shocks, then we might wrongfully attribute the mitigating effects to the speed of firm exit. This problem is potentially acute because the short and recent time span of the *Doing Business* indicators does not permit an analysis based on changes. To address this potential omitted variable problem, we performed a range of robustness checks. First, we re-estimated the specification of Table 5, column (1), but including interactions of the price shock variables with each of the other thirty-five Doing Business indicators separately.[27] The results for all the thirty-five regressions together suggest that it is really the speed of firm exit that is important in mitigating the growth loss from adverse commodity export price shocks and not any other Doing Business indicator.[28] Table 5, column (2), shows the results for the specification in which we

[27] Doing Business captures regulation in ten areas. In addition to "Employing Workers" and "Closing a Business", the indicators of which we already use, these areas are "Starting a Business", "Dealing with Construction Permits", "Registering Property", "Getting Credit", "Protecting Investors", "Paying Taxes", "Trading Across Borders" and "Enforcing Contracts". For each indicator, we calculate the average 2004-2007 value and then rescale this average so that it ranges from 0 to 1, with higher values corresponding to more flexibility. We express indicators with an ordinal scale as dummy variables that for all sample years take a value of one (zero) if the country-specific average level of flexibility over all available years is above (below) the median of all countries.

[28] The lagged adverse price shock always enters with a negative sign and the significance level of the coefficient is relatively robust: 1% in 23 specifications, 5% in 8 specifications, 10% in 2 specifications and insignificant in 2 specifications. The coefficient of the interaction between the shock and the speed of firm exit is always positive and the significance level of the coefficient is also relatively robust: 1%

add an interaction of the shock variable with a speed of firm entry indicator (based on the time to start a business (World Bank, 2007)).

In addition to the characteristics captured by the Doing Business indicators, our results may also be explained by other institutional characteristics or policies that may mitigate shocks. To investigate this possibility, we divided the countries in our sample according to whether their speed of bankruptcy procedures is above the median of all countries or below it. We then calculated the averages of twelve alternative indicators of governance quality[29] and the shares of commodity exports in GDP in both groups of countries. We find that countries with a relatively high speed of firm exit on average have better institutions and slightly less natural resources than countries with a low speed of firm exit. The positive correlation between speed of firm exit and

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in 19 specifications, 5% in 14 specifications and insignificant in two specifications. The coefficients of the interactions between the shock and the other Doing Business indicators are statistically *insignificant* in 27 specifications, significant at 10% in 3 specifications, significant at 5% in 2 specification and significant (but with the "wrong sign") at 1 percent in 3 specifications. In the two specifications where the interaction with speed of firm exit is (just) insignificant, the coefficient is still negative and only slightly smaller in size. Moreover, the interaction with the other Doing Business indicator is either negative or small positive and in both cases insignificant.

[29] Six governance indicators are from Kaufmann, Kraay and Mastruzzi (2008), i.e. voice and accountability, political stability, government effectiveness, regulatory quality, rule of law and control of corruption. We also use six other governance indicators: civil liberties (Freedom House), political rights (Freedom House), political constraints (polconv, Henisz, 2002), democracy (Polity IV), autocracy (PolityIV) and checks and balances (Database of Political Institutions). All indicators are introduced as dummy variables that for all sample years take a value of one if the country-specific average level of institutional quality over all available years is above the median of all countries and zero if it is below the median of all countries.

quality of governance adds to the concern that our results may be due to omitted variable bias. To investigate whether this is likely, we again re-estimated the specification of Table 5, column (1), but this time including interactions of the shock variables with each of the twelve governance indicators separately.

We do not find a mitigating effect of institutions on the impact of shocks on growth. In addition, controlling for any effect that institutions may have does not change our finding that countries with more flexible firm exit procedures suffer less from adverse price shocks.[30]

As a final robustness check to address potential omitted variable bias, we consider two policies that have already been shown to effectively mitigate the growth effect of adverse price shocks: exchange rate flexibility (Broda, 2004) and aid (Collier and Goderis, forthcoming). We next add our indicators[31] of exchange rate flexibility and aid to the specification of Table 5, column (1), both individually and interacted with each of the four commodity export price shocks.[32] The results are reported in Table 5,

[30] In all 12 specifications, the coefficient of the lagged adverse price shock is negative and statistically significant at 1%, as in Table 5, column (1). The coefficient of the interaction between the shock and the speed of firm exit is always positive and is significant at 1% in 10 specifications and at 5% in 2 specifications. Finally, the coefficients of the interactions between the shock and the institutional indicators are *insignificant* in 9 specifications, significant at 10% in 2 specifications and significant at 5% in 1 specification (for political stability, but with the counterintuitive sign).

[31] For exchange rate flexibility, we use a dummy based on Reinhart and Rogoff (2004), which takes a value of zero for course classification code = 1, and one for all other categories. For aid , we use official development assistance (% of GNI) from OECD IDS).

[32] Since aid is endogenous, we use IV estimation (see Collier and Goderis, forthcoming).

column (3). Although the interactions of the lagged price shock with exchange rate flexibility and aid enter with the expected sign, neither coefficient is significant. The coefficients of the lagged price shock and the interaction of the shock with speed of firm exit, on the other hand, gain in terms of size and significance.

While the lack of a long data series on the regulation of firm exit inevitably raises concerns about endogeneity, the above results substantially address them. We have found that it is the specific indicator of the speed of firm exit which is important, as opposed to the many other aspects of the business environment, policies and institutional quality, which we are able to measure and with which it might potentially have been correlated. Further, there are plausible channels whereby the prolonged inability to close a firm might amplify an adverse business shock.

Having addressed concerns of endogeneity, we next investigate whether our results are robust to alternative shock measures. Recall that our commodity export price shock episodes were defined as the observations with residuals above the 90th or below the 10th percentile in the estimation specification of equation (1). For sensitivity, we change these thresholds to the 95th and the 5th percentile, which reduces the number of shock episodes. Using this alternative measure of shocks, we re-estimate the specification in Table 5, column (1). The results, reported in Table 5, column (4), show that the estimated coefficients are strongly robust and even gain in size and significance.

As a second robustness check, we reconstruct the commodity export price shocks using a different criterion to identify shock episodes. Instead of using equation (1) to

remove the predictable component of shocks, we now simply define shock episodes as the observations for which the first difference of the log annual commodity export price index either lies above the 90th percentile of its distribution (positive shocks) or below the 10th percentile (negative shocks). The results, reported in Table 5, column (5), show that our findings are robust.

We next investigate whether the effects vary across different types of shocks. We distinguish between non-agricultural price shocks and agricultural price shocks and construct measures for each of these, using the methodology described in section 2.1. We also construct interactions of both of these measures with the speed of firm exit indicator. We replace the shock and its interaction with speed of firm exit in Table 5, column (1), by the two separate shock measures and their interactions with speed of firm exit and rerun the specification. The results are reported in Table 5, column (6). The non-agricultural price shock enters with a negative sign and its coefficient is statistically significant at 1 percent. The interaction of non-agricultural price shocks with speed of firm exit has a positive sign and is significant at 5 percent. Hence, the results for non-agricultural shocks are entirely consistent with the results we found for the general commodity export price shocks. By contrast, the agricultural price shock and its interaction with speed of firm exit have the opposite signs, while their coefficients are far from statistically significant. This indicates that our findings were driven by the non-agricultural export price shocks.

Two distinctions between the revenues from the extractive sector and those from the agricultural sector might account for this difference. One is that in the former sizeable revenues accrue to the government whereas in the latter revenues accrue

predominantly to farmer households. The difference in the consequences of shocks for growth may therefore be because farm households are more adept at cushioning spending in response to shocks than are governments. In this case the rest of the economy has less need to adjust so that the speed of firm exit might not show up as important. A second evident difference is that the rural economy is largely informal. As a result the regulatory regime would not matter because it is not enforced in the rural economy. A further implication of rural informality might be that shocks within it are well-absorbed by price and employment flexibility, mitigating the effects on the formal economy. In contrast, extractive shocks accrue to the formal economy, directly hitting the government and extractive companies, and having knock-on effects for their suppliers. Evidently, it is the formal economy which would be most affected by regulations on firm exit.

As four final robustness checks, we experiment with alternative sets of control variables. We first strip the specification in Table 5, column (1), by removing the vectors of long-run GDP determinants, $x_{i,t-1}$ and $l_{i,t\text{-}1}$, and the lagged level of GDP per capita, $y_{i,t-1}$. This transforms the model from a cointegration model to an autoregressive distributed lag (ARDL) model. The results from estimating this model are reported in Table 5, column (7). Our results are robust. We then strip the specification in Table 5, column (1), three more times. First, we remove all control variables that were not significant (results in Table 5, column (8)). Secondly, we drop the trade openness variables (results in Table 5, column (9)). And finally, we drop the lagged dependent variable (results in Table 5, column (10)). The results are robust.[33]

[33] We also tested the robustness of our findings to employing cross-sectional OLS estimation (results available upon request). We find no significant effect of commodity export price volatility (the

Natural Disasters

We next consider the robustness of our finding that labour market flexibility cushions the adverse effect of natural disasters. As a first check, we re-estimate the specification of Table 4 without the interaction of the natural disaster indicator with the indicator of speed of firm exit. The results are reported in Table 6, column (1). The coefficients of the natural disaster variable and its interaction with employment flexibility are now both significant at 1 percent, although smaller in size.

To allow for the possibility that the effects vary across different types of natural disasters, we replace the total number of disasters and its interaction with employment flexibility in Table 6, column (1), by three separate variables that capture the number of geological, climatic, and humanitarian disasters and interactions of each of these variables with employment flexibility. The results are reported in Table 6, column (2). The indicator of geological shocks enters with a negative sign and is significant at 10 percent, while its interaction with the flexibility of employment has a positive but insignificant coefficient. The size of both coefficients is larger than the size of the

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country-specific standard deviation of the price index) on average GDP growth. However, we do find that the volatility of prices significantly increases the *volatility* of growth. We also find that this effect is significantly smaller in countries with higher speeds of firm exit. These results are consistent with our panel data findings, which show that negative export price shocks lead to lower short run growth but that shocks do not have an effect on long run GDP, and that the short run effect of shocks is smaller in countries with more flexible bankruptcy procedures. An additional finding from the cross-sectional analysis is that both the speed of firm exit and the flexibility of employment have a positive *direct* effect on average growth, although not statistically significant.

coefficients in column (1), suggesting that the results for geological shocks, although less significant, are consistent with the general effects found in column (1) or even slightly stronger. The coefficients for climatic shocks are almost identical to the ones in column (1), both in terms of size and statistical significance, suggesting that our findings for natural disasters are predominantly driven by climatic shocks. By contrast, the indicator of humanitarian disasters and its interaction with employment flexibility enter with signs opposite to the signs of the coefficients in column (1), while their coefficients are not significant.

Again, the results should be interpreted with caution, as the coefficients may suffer from endogeneity. As before, endogeneity could relate to the shocks, the policies, or both. Natural disasters may for example occur more often in countries with particular geographical characteristics that could also affect growth. However, since our estimation model includes country-specific fixed effects, we effectively control for all time invariant growth determinants, including a country's geography. Hence, our indicator of natural disasters is not likely to suffer from endogeneity.

To address the possible endogeneity of the policy variables, we first repeat the robustness exercises of the previous subsection and separately add the other Doing Business indicators, institutional indicators[34], and exchange rate flexibility and aid to the specification of Table 6, column (1). We do not find evidence that our finding that

[34] When comparing countries with a flexibility of employment above the median of all countries with countries below the median, we found that countries above the median on average have better institutions and slightly more natural resources than countries below the median, while exchange rate flexibility and aid are on average the same.

flexibility of employment mitigates the growth effect of natural disasters is explained by a correlation between flexibility of employment and any of the other Doing Business indicators[35], any of the institutional quality variables[36], or exchange rate flexibility and aid (results reported in Table 6, column (3)).

We also test the robustness of our results for natural disasters by replacing the indicator of the number of natural disasters by a dummy variable that takes a value of one if a country has one or more disasters in a given year, and zero otherwise. The results, reported in Table 6, column (4), show that our results are robust.

So far we have used the labour market flexibility indicator from the World Bank's Doing Business database. To further investigate whether flexibility indeed matters, we also tested the robustness of our findings to using an indicator from a different data

[35] In the specifications for the 35 other Doing Business indicators, the natural disaster variable always enters with a negative sign but the statistical significance level of the coefficients is less robust than for export price shocks: 1% in 6 specifications, 5% in 13 specifications, 10% in 4 specifications and insignificant in 12 specifications. The coefficient of the interaction of the natural disaster variable with the flexibility of employment indicator is always positive and the significance level of the coefficient is robust: 1% in 26 specifications and 5% in 9 specifications. The coefficients of the interactions between the natural disaster variable and the other Doing Business indicators are insignificant in 31 specifications, while significant at 10% in 3 specifications and significant at 5% in 1 specification.

[36] In the specifications for the 12 indicators of institutional quality, the natural disaster variable always enters with a negative sign, while the significance level of the coefficient is robust: 1% in 8 specifications and 5% in 4 specifications. The coefficient of the interaction of the natural disaster variable with the flexibility of employment indicator is always positive, while the coefficient is always significant at 1 percent. The coefficients of the interactions between the natural disaster variable and the institutional indicators are never statistically significant.

source. In particular, we collected data on the flexibility of wage determination and hiring and firing practices from the World Economic Forum's (WEF) Global Competitiveness Report 2008/2009 (GCR). The GCR data are based on a worldwide executive survey and provide measures of *de facto* labour market flexibility, whereas the Doing Business indicators capture *de jure* labour market flexibility. Our common estimation sample in Table 2 included 129 countries, 377 positive export price shocks, 392 negative export price shocks, 688 episodes of one or more natural disasters and 38 countries with more than 10 percent commodity exports to GDP. If we restrict the sample to countries available in the GCR, the sample includes 98 countries, 290 positive shocks, 290 negative shocks, 545 episodes of one or more natural disasters and 28 countries with more than 10% commodity exports to GDP.

Using the GCR variables 7.02 ("Flexibility of Wage Determination") and 7.05 ("Hiring and Firing Practices"), we construct a composite measure of flexibility of employment in the following way. We first normalize the two variables so that they range from 0 to 1 and rescale them so that a higher value corresponds to a more flexible labour market (so as to ease comparison to the original results using the normalized and rescaled Doing Business indicators). We then use the average of the two normalized and rescaled variables in our estimations.[37] The correlation between this measure of employment flexibility and the employment flexibility indicator based on Doing Business is 0.41. This relatively low correlation is consistent with the findings in Chor and Freeman (2004) for an alternative *de facto* indicator of

[37] The Doing Business database constructs its composite measure of rigidity of employment in a similar way. While the Doing Business indicators have an ordinal scale, the GCR data have a cardinal scale and so we do not introduce them as dummy variables.

flexibility. They suggest that the low correlation presumably reflects the divergence between regulations and implementation.

Using the alternative indicator of employment flexibility based on the GCR data, we test the robustness of our finding that flexibility of employment significantly mitigates the growth effect of natural disasters.[38] In particular, we re-estimate all specifications that included the natural disaster variable and the labour market flexibility measure based on the Doing Business database. Our findings are strongly robust to using the indicator based on the GCR. The natural disaster variable always enters with a negative sign and is statistically significant at 1 percent in seven specifications, while significant at 5 percent in one specification. The interaction of the shock with employment flexibility always enters with a positive sign and is significant at 5 percent in seven specifications, while significant at 1 percent in one specification. The size of the coefficients for both the natural disaster variable and its interaction with flexibility is considerably larger than before, suggesting that our original estimates may represent a lower bound on the true effects. For the specification of Table 6, column (1), the results of this exercise are reported in Table 6, column (5).[39] [40]

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[38] We also tested whether the flexibility of employment has a significant impact on the effect of the (lagged) adverse commodity export price shock. Consistent with our results when using the Doing Business variables, we do not find evidence of such an effect.

[39] We also re-estimated the specification of Table 6, column (2), using the flexibility indicator based on GCR. Our earlier finding that the effect is most relevant for climatic and geological shocks was robust.

[40] The coefficient of the interaction term is bigger than the coefficient of the shock by itself. However, given that the flexibility of employment indicator ranges from 0.37 to 0.81 for the countries in this estimation sample, the net growth effect of natural disasters ranges from -1.2 % points (significant at 1 percent) for a country with the least flexible labour market (flex. of employment = 0.37) to 0.2 %

We also investigated the sensitivity of our results to using the *continuous* employment flexibility indicator (based on Doing Business) instead of the dummy variable we have used so far. We again re-estimate all specifications that included the natural disaster variable and the labour market flexibility measure based on the Doing Business database but we now replaced the labour market flexibility dummy by its corresponding continuous variable. Our results are robust in terms of significance and the size of the coefficients again increases.[41] For the specification of Table 6, column (1), the results of this exercise are reported in Table 6, column (6).[42]

Finally, in Table 6, columns (7) to (10), we again experiment with alternative sets of controls. In column (7) we remove the vectors of long-run GDP determinants and the lagged level of GDP per capita, while in columns (8) to (10) we remove all control variables that were not significant, the trade openness variables, and the lagged dependent variable, respectively. The results are robust.

5. Conclusions

points (insignificant, p-value = 0.49) for countries with the most flexible labour market. The latter effect is far from statistically significant and close to zero.

[41] The natural disaster variable always enters with a negative sign and is statistically significant at 1 percent in all eight specifications. The interaction of the shock with employment flexibility always enters with a positive sign and is significant at 1 percent in six specifications and at 5 percent in two specifications.

[42] Our finding that the effect is most relevant for climatic and geological shocks is also robust.

At a time when the volatility and unpredictability of commodity prices has been dramatically demonstrated, it is appropriate to consider the consequences of large and unanticipated price declines. We have focused on structural policies that are well-suited to mitigating such adverse shocks. The advantage of structural policies is that they do not depend upon a government responding in a timely and appropriate manner to a price deterioration. Actual responses may fall far short of the ideal both because policy change is a slow process, and because determining at the onset of a price shock its likely scale and duration may be infeasible. In contrast, structural policies can be put in place at any time prior to an adverse shock and then simply left alone.

We have investigated the efficacy of a range of structural policies. Some policies, notably financial depth and openness, despite having received much emphasis in the policy literature, appear not to have significant net effects. In contrast, we find that some regulatory policies which have been neglected appear to have large effects which differ according to the type of shock. We have distinguished between adverse price shocks to mineral exporters and those to agricultural exporters, compared these adverse price shocks to positive price shocks, and finally compared price shocks to natural disasters.

We find that regulations that delay the speed of firm closure, significantly and substantially increase the short-term growth loss from adverse price shocks in mineral-exporting countries and that if those delays are severe the growth loss from such shocks is typically very substantial. We have suggested that delays in firm exit may amplify the short-term growth loss from a shock by impeding credit and locking up scarce entrepreneurship. In contrast, adverse agricultural price shocks do not

generate significant losses and regulations that delay firm exit are of no consequence for shock mitigation. We have suggested that this may be because rural households are better at smoothing their consumption than is government, and that the informality of the rural economy facilitates adjustment and makes regulations irrelevant. Positive price shocks do not typically generate significant short term increases in real output. Here the explanation for the asymmetry with negative shocks is likely to be that the economy is normally operating near its short term production potential. Natural disasters typically have only relatively small adverse effects on aggregate output. However, the policies that appear able to mitigate these costs are distinctive. The speed of firm exit is not significant, but labour market flexibility substantially reduces the short-term output losses. We have suggested that these distinctive aspects of natural disasters may be because as predominantly rural phenomena they dislocate people more than firms.

We have subjected these results to a range of robustness tests. While our underlying measures of regulatory policies are too recent to be time-variant, by introducing an extensive range of controls for other regulations, for other policies, and for institutional quality, we have addressed reasonable concerns regarding endogeneity. Similarly, we have shown that the consequences of commodity price shocks are robust to concerns that they might be endogenous to supply shocks in exporting countries.

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Table 1a: Summary statistics

	Obs.	Mean	St. Dev.	Min.	Max.
Real GDP per capita (log)	3608	7.54	1.55	4.31	10.55
Trade to GDP	3608	0.64	0.36	0.06	2.51
Inflation (log (1 + inflation rate))	3608	0.14	0.29	-0.24	5.48
Reserves to GDP	3608	0.09	0.10	0.00	1.24
Annual commodity export price index (1980 = 100)	3608	81.07	26.87	15.10	230.05
Weighted log annual commodity export price index	3608	0.34	0.36	0.00	1.97
Commodity exports to GDP	3608	0.08	0.09	0.00	0.45
Commodity export price volatility	3608	0.01	0.01	0.00	0.08
Oil import price index	3608	3.11	1.85	0.00	4.96
Δ GDP per capita (log)	3608	0.02	0.05	-0.36	0.30
Δ Trade to GDP	3608	0.01	0.08	-0.88	1.21
Δ Inflation (log (1 + inflation rate))	3608	-0.00	0.19	-3.62	2.52
Δ Reserves to GDP	3608	0.00	0.03	-0.25	0.31
Coup	3608	0.03	0.17	0	2
Civil war	3608	0.07	0.26	0	1
Flexible exchange rate	2907	0.62	0.49	0	1
Aid (log)	2785	1.43	1.00	-0.92	4.38
Flexibility of employment	124	0.47	0.50	0	1
Speed of firm exit	110	0.73	0.17	0	1
Speed of firm entry	122	0.50	0.13	0.19	1
	Number	Mean	St. Dev.	Min.	Max.
Positive commodity export price shocks (unweighted)	377	0.29	0.17	0.09	1.03
Negative commodity export price shocks (unweighted)	392	0.26	0.14	-0.01	0.81
Natural disasters	688	1.32	0.59	1	4

Notes: Our indicators of flexibility of employment and speed of firm exit and entry are based on cross-sections of average 2004-2007 values for 124, 110 and 122 countries, respectively. We use these average values for all the years in our sample.

Table 1b: Commodities

aluminum^n	nickel^n	zinc^n	Copra	groundnutoil	Poultry	soybeans	wool
phosphatrock^n	oil^n	bananas	cotton	groundnuts	Pulp	sugar	
copper^n	coal^n	Barley	Fish	oranges	Rice	sunfloweroil	
gasoline^n	silver^n	Butter	Maize	palmkerneloil	Rubber	swinemeat	
ironore^n	tin^n	cocoabeans	pepper	palmoil	Sisal	tea	
uranium^n	lead^n	coconutoil	Hides	oliveoil	Sorghum	tobacco	
natural gas^n	urea^n	Coffee	Jute	plywood	Soybeanoil	wheat	

n = non-agricultural commodities

Table 2: Estimation results cointegration model

Long-run coefficients		***Short-run coefficients (cont'd)***	
Trade to GDP	0.465***	Δ Reserves to GDP_{t-1}	0.054
	(0.134)		(0.035)
Inflation (log)	-0.188**	Δ (GDP per capita (log))$_{t-1}$	0.140***
	(0.077)		(0.029)
Reserves to GDP	0.701***	$Coup_t$	-0.031***
	(0.253)		(0.007)
Commodity export price index	-1.086***	Civil war_t	-0.022***
	(0.350)		(0.005)
Oil import price index	-0.118	Positive price $shock_t$	0.049
	(0.084)		(0.076)
Commodity exp. price volatility	3.020	Positive price $shock_{t-1}$	0.087
	(4.404)		(0.057)
Short-run adjustment coefficient		Negative price $shock_t$	-0.070
GDP per capita $(log)_{t-1}$	-0.061***		(0.069)
	(0.008)	Negative price $shock_{t-1}$	-0.358***
Short-run coefficients			(0.109)
Δ Trade to GDP_{t-1}	0.018	Natural $disaster_t$	-0.037**
	(0.015)		(0.015)
Δ Inflation $(log)_{t-1}$	-0.003		
	(0.004)		
Number of observations	3608	R-squared within	0.26
Number of countries	129		

Notes: The dependent variable is the first-differenced log of real GDP per capita in year t. All regressions include country fixed effects and regional time dummies. Robust standard errors are clustered by country and are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The long-run coefficients correspond to $-(1/\lambda)\bullet\beta_1$ and $-(1/\lambda)\bullet\beta_2$ in equation (2).

Table 3: The effect of negative commodity export price shocks

Long-run coefficients		***Short-run coefficients (cont'd)***	
Trade to GDP	0.576***	Positive price shock$_t$	0.480
	(0.151)		(0.401)
Inflation (log)	-0.219***	Positive price shock$_t$ * flex. of employment	0.149
	(0.074)		(0.131)
Reserves to GDP	0.989***	Positive price shock$_t$ * speed of firm exit	-1.613
	(0.254)		(0.562)
Commodity export price index	-0.778*	Positive price shock$_{t-1}$	0.133
	(0.422)		(0.341)
Oil import price index	-0.082	Positive price shock$_{t-1}$* flex. of employment	-0.063
	(0.087)		(0.179)
Commodity exp. price volatility	-0.886	Positive price shock$_{t-1}$* speed of firm exit	-0.105
	(4.727)		(0.549)
Short-run adjustment coefficient		Negative price shock$_t$	-0.123
GDP per capita (log)$_{t-1}$	-0.062***		(0.300)
	(0.009)	Negative price shock$_t$* flex. of employment	-0.176
Short-run coefficients			(0.148)
Δ Trade to GDP$_{t-1}$	0.016	Negative price shock$_t$* speed of firm exit	0.205
	(0.019)		(0.484
Δ Inflation (log)$_{t-1}$	-0.001	Negative price shock$_{t-1}$	-1.142***
	(0.004)		(0.353)
Δ Reserves to GDP$_{t-1}$	0.070*	Negative price shock$_{t-1}$* flex. of employment	0.001
	(0.036)		(0.125)
Δ (GDP per capita (log))$_{t-1}$	0.150***	Negative price shock$_{t-1}$* speed of firm exit	1.199***
	(0.032)		(0.431)
Coup$_t$	-0.032***		
	(0.007)		
Civil war$_t$	-0.017***		
	(0.005)		
Natural disaster$_t$	-0.040**		
	(0.017)		
Number of observations	3198	R-squared within	0.30
Number of countries	110		

Notes: The dependent variable is the first-differenced log of real GDP per capita in year t. All regressions include country fixed effects and regional time dummies. Robust standard errors are clustered by country and are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The long-run coefficients correspond to $-(1/\lambda)\bullet\beta_1$ and $-(1/\lambda)\bullet\beta_2$ in equation (2).

Table 4: The effect of natural disasters

Long-run coefficients		***Short-run coefficients (cont'd)***	
Trade to GDP	0.565***	Δ (GDP per capita (log))$_{t-1}$	0.147***
	(0.146)		(0.030)
Inflation (log)	-0.212***	Coup$_t$	-0.033***
	(0.074)		(0.007)
Reserves to GDP	1.068***	Civil war$_t$	-0.017***
	(0.257)		(0.005)
Commodity export price index	-0.800*	Positive price shock$_t$	0.119
	(0.418)		(0.075)
Oil import price index	-0.088	Positive price shock$_{t-1}$	0.041
	(0.085)		(0.065)
Commodity exp. price volatility	-0.835	Negative price shock$_t$	-0.051
	(4.380)		(0.069)
Short-run adjustment coefficient		Negative price shock$_{t-1}$	-0.314***
GDP per capita (log)$_{t-1}$	-0.062***		(0.118)
	(0.009)	Natural disaster$_t$	-0.135**
Short-run coefficients			(0.065)
Δ Trade to GDP$_{t-1}$	0.018	Natural disaster$_{t*}$ flex. of employment	0.113***
	(0.018)		(0.029)
Δ Inflation (log)$_{t-1}$	-0.001	Natural disaster$_{t*}$ speed of firm exit	0.055
	(0.005)		(0.080)
Δ Reserves to GDP$_{t-1}$	0.063*		
	(0.036)		
Number of observations	3198	R-squared within	0.30
Number of countries	110		

Notes: The dependent variable is the first-differenced log of real GDP per capita in year t. All regressions include country fixed effects and regional time dummies. Robust standard errors are clustered by country and are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The long-run coefficients correspond to $-(1/\lambda)\bullet\beta_1$ and $-(1/\lambda)\bullet\beta_2$ in equation (2).

Table 5: The effect of negative commodity export price shocks – robustness checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Shock	-1.13***	-1.16***	-2.24***	-1.20***	-1.11***		-1.18***	-1.19***	-1.19***	-1.14***
	(0.40)	(0.36)	(0.43)	(0.39)	(0.40)		(0.40)	(0.40)	(0.39)	(0.41)
Shock * speed of firm exit	1.19**	1.51***	2.42***	1.32***	1.16**		1.22**	1.29**	1.22**	1.17**
	(0.49)	(0.49)	(0.64)	(0.48)	(0.50)		(0.50)	(0.51)	(0.48)	(0.50)
Shock * speed of firm entry		-0.46								
		(0.54)								
Shock * flex. exchange rate			0.13							
			(0.21)							
Shock * aid			0.17							
			(0.12)							
Shock non-agri						-1.13***				
						(0.41)				
Shock non-agri * speed of firm exit						1.21**				
						(0.51)				
Shock agri						0.73				
						(1.34)				
Shock agri * speed of firm exit						-1.36				
						(1.89)				
Method	FE	FE	FE-IV	FE	FE	FE	FE-ARDL	FE	FE	FE
Number of observations	3198	3157	1212	3198	3201	3198	3198	3255	3460	3202

Notes: The dependent variable is the first-differenced log of real GDP per capita in year t. All regressions include country fixed effects and regional time dummies. Robust standard errors are clustered by country and are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Only the coefficients and standard errors of the variables of interest are reported. The variable "shock" corresponds to the lagged negative price shock, "shock non-agri" denotes the lagged negative non-agricultural price shock and "shock agri" represents the lagged negative agricultural price shock. The specifications of columns (1) to (6) include all controls of Table 3, except for the interactions of the shocks with employment flexibility. In column (7), the long run controls are dropped. In column (8), the insignificant controls from Table 2 and their interactions are dropped. In column (9), the trade openness variables are dropped. In column (10), the lagged dependent variable is dropped.

Table 6: The effect of natural disasters – robustness checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Shock	-0.07***		-0.15**	-0.09***	-0.24***	-0.14***	-0.07***	-0.07***	-0.08***	-0.08***
	(0.02)		(0.07)	(0.03)	(0.08)	(0.04)	(0.02)	(0.02)	(0.02)	(0.02)
Shock * flex. of employment	0.08***		0.10**	0.11**		0.21***	0.07**	0.08**	0.08**	0.08***
	(0.03)		(0.04)	(0.04)		(0.07)	(0.03)	(0.03)	(0.03)	(0.03)
Shock geo		-0.12*								
Shock geo * flex. of employment		0.12								
Shock clim		-0.07***								
Shock clim * flex. of employment		0.09***								
Shock hum		0.05								
Shock hum * flex. of employment		-0.29								
Shock * flex. exchange rate			-0.01							
			(0.04)							
Shock * aid			0.03							
			(0.02)							
Shock * flex. of employment (WEF)					0.33**					
					(0.14)					
Method	FE	FE	FE-IV	FE	FE	FE	FE-ARDL	FE	FE	FE
Number of observations	3513	3513	1284	3513	2946	3513	3513	3565	3832	3517

Notes: The dependent variable is the first-differenced log of real GDP per capita in year t. All regressions include country fixed effects and regional time dummies. Robust standard errors are clustered by country and are reported in parentheses, except for the geological, climatic and humanitarian shocks (to save space). ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Only the coefficients and standard errors of the variables of interest are reported. The variable "shock" corresponds to the natural disasters indicator. "Shock geo", "Shock clim" and "Shock hum" capture geological, climatic and humanitarian disasters. "flex. of employment (WEF)" denotes the indicator of employment flexibility based on data from the World Economic Forum's Global Competitiveness Report. The specifications of columns (1) to (6) include all controls of Table 4, except for the interactions of the shock with the speed of firm exit. In column (7), the long run controls are dropped. In column (8), the insignificant controls from Table 2 and their interactions are dropped. In column (9), the trade openness variables are dropped. In column (10), the lagged dependent variable is dropped.