EXPORT DIVERSIFICATION AS AN ABSORBER OF EXTERNAL SHOCKS

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ABSTRACT

This paper investigates the role of export diversification as a shock absorber. In particular, we study whether diversification increases or decreases the economy's exposure to external shocks, measured by output volatility. Throughout the analysis we pay special attention to determine whether diversification affects developed and developing economies in different ways. We also distinguish between product and geographic diversification. We find that for lower income countries product differentiation plays an important role in lowering income volatility. The richer countries get the less important the role of product diversification and the more important the role of geographical diversification.

Keywords: income volatility, export diversification, external shocks.

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1. **INTRODUCTION**

Open economies are subject to external shocks and Rodrik (1998) has argued that more open economies have bigger governments, because government spending is used to smoothen those external shocks. Output volatility can, indeed, have serious implications. Ramey and Ramey (1995) have shown that countries with higher output volatility tend to grow more slowly and Aizenmann and Marion (1999) have found that higher volatility reduces private investment. There is also evidence that the adverse effects of output drops are felt most strongly by the poorest households who lack the resources to smooth consumption. As shown in figure 1, output volatility is considerably higher for developing countries than for developed countries. Interestingly, while output volatility in developing countries has fluctuated considerably over the last 40 years, its level in 2004 is slightly higher than what it was back in the 1960s.

**Figure 1: Output volatility by group of countries.**

The sources of output volatility are not well understood. A small number of papers focus on external sources of volatility and explore the role of terms-of-trade volatility, the degree of openness to trade
and size.\(^3\) They find that higher terms-of-trade volatility lead to higher output volatility. Researchers have also considered other sources of volatility. Malik and Temple (2006) distinguish three strands in the literature in addition to the one that is concerned with external sources. One strand of the literature emphasizes the role of governance. Domestic policy mismanagement resulting in high inflation, overvalued exchange rates or sustained budget deficits can indeed contribute to volatility. A second strand emphasizes the role of the financial sector. While domestic financial development could in principle help dampen output fluctuations in a number of ways, there is only mixed evidence in support of this approach. A third approach focuses on the role of institutional and political factors. Indeed, there is some evidence that democracy is associated with less variable outcomes than autocracy, both across countries and over time.

Malik and Temple (2006) use recently developed Bayesian methods to examine the structural determinants of output volatility. They find that terms-of-trade volatility has explanatory power for output volatility regardless of the choice of conditioning variables, which supports the view that external shocks are fundamental to explaining volatility in poorer countries. They also find that export diversification has substantial explanatory power although it is lower than that of terms of trade volatility. Among the other variables with high explanatory power are initial population size, initial income, a dummy for landlocked countries, a variable measuring the suitability of the soil for six rain fed crops and one that measures the distance from the nearest coastline or sea-navigable river. It is interesting to observe that these variables can all be related to trade and external shocks. Among the variables related to domestic shocks, results suggest that volatility is generally higher in countries that have fought external wars over the sample period, especially countries with ethnic divisions.

This paper focuses on external sources of volatility. The relevant literature has typically found that both export diversification and terms-of-trade volatility are strong predictors of output volatility. More precisely, they find that each of those two variables has high explanatory power when the other is excluded from the regression equation. Some authors go one step further and examine the determinants of terms-of-trade volatility (Malik and Temple, 2006, Jansen, 2004). Malik and Temple (2006) find that relatively few variables have explanatory power for terms-of-trade volatility. Export concentration stands out as the only strong predictor of terms-of-trade volatility among the variables taken into consideration. Export concentration in terms of product basket thus appears to affect income volatility through its effect on terms of trade volatility.

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This paper contributes to the existing literature by analysing the role of another variable that may affect exposure to external shocks. Countries do not only differ in the level of diversification of their product basket, they also differ in the level of diversification of their export markets. While some countries serve a large number of markets spread around the globe, others concentrate their exports on a reduced number of countries, often within the same region. The economic performance in trading partners is likely to affect exports to those trading partners. Countries whose main export markets are very volatile are, therefore, more likely to “import” volatility from their trading partners and more exposed to external fluctuations. The larger the set of trading partners and the more stable the economies of those trading partners, the lower the probability that fluctuations in the foreign economies affect the exporting country. We analyse this question by introducing measures for geographical diversification into regressions explaining income volatility.

The rest of this paper is structured as follows. Section 2 introduces the measures of exposure to external risk used in this paper with a particular focus on measures reflecting the exposure to fluctuations in trading partners. Section 3 presents the empirical analysis and section 4 concludes.

2. **EXPOSURE TO EXTERNAL RISK**

a) **Product and geographical diversification**

We are interested in comparing the effects of product and geographical diversification on output volatility. Most of past research has focused on product diversification. The underlying idea is that countries which export a narrow range of products experience stronger terms of trade volatility. This is partly because concentration is typically highest for natural resource exporters and empirical evidence suggests that terms-of-trade fluctuations are greatest for fuel exporting countries, followed by primary commodity exporters, followed by countries that specialize in manufacturing exports (Baxter and Kouparitsas, 2000). This paper explores the role of geographic diversification. The idea here is that geographical diversification may act as a buffer against the possibility that fluctuations in other economies affect exporting countries through existing commercial linkages.
To measure product and geographic diversification, we use a large data set including SITC 3-digit level trade data for a group of 191 countries for the period from 1962 to 2004. Using this data set we have calculated the value of each country’s total exports, and the Herfindahl Index of export (product and geographic) concentration. The $H_{i,t}^G$ is the Herfindahl index of geographic concentration for country $i$ at time $t$; and $H_{i,t}^P$ is the Herfindahl index of product concentration for country $i$ at time $t$.

Figure 2 shows that product concentration is lowest for developed countries, and highest for least developed countries. For developing countries, diversification has been increasing steadily over our sample period. Figure 3 in turn shows a similar picture for geographic diversification. Developed countries are the most diversified but the difference between LDCs and developing countries is less clearcut. Also, unlike their product concentration, the geographic concentration of developing country exports has steadily declined over our sample period.

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4 International Trade by Commodity Statistics (Rev. 3) which contains 4346 products, (Source OECD website) (261 products at the 3 digit: Referred as groups).

5 This index is a measure of export concentration that ranges from zero (low concentration) to one (high concentration). The formula is the following:

$$H_{i,t}^P = \sqrt{\frac{\sum_{i} \left( \frac{x_i}{X} \right)^2 - \sqrt{1/261}}{1 - \sqrt{1/261}}} \quad H_{i,t}^G = \sqrt{\frac{\sum_{i} \left( \frac{x_i}{X} \right)^2 - \sqrt{1/191}}{1 - \sqrt{1/191}}}$$

where, $j$ is the country index, $i$ is the 3-digit category, $x$ refers to exports and 261 is the universe of 3-digit product lines.
Figure 2: Herfindahl index of product concentration

Figure 3: Herfindahl index of geographic concentration
Reducing the geographical concentration of exports by serving a larger number of export markets helps to diversify the risks of exposure to external shocks. But the success of such a strategy is likely to depend quite significantly on the type of export markets that are served. For a given level of geographical diversification, exposure to external fluctuations is likely to be larger the more volatile the markets that are served. The level of volatility of trading partners is not at all taken into account in the Herfindahl index of geographical concentration.

We therefore create a measure that takes this volatility of trading partners into account by constructing a variable we call “imported demand shocks”. This variable for country \( i \) is defined as the weighted average of income volatility across country \( i \)'s export markets where each partner \( j \)'s income volatility is weighted by its share in \( i \)'s total exports:

\[
IDS_i = \sum_j \frac{x_{i,j}}{X_i} GDP_{vol_j}
\]

Where \( \frac{x_{i,j}}{X_i} \) represents the share of exports to country \( j \) in country \( i \)'s total exports.

As can be seen from Figure 2, imported demand shocks are weakest for developed countries and strongest for LDCs.

Figure 4: Demand shocks by group of countries.
b) Terms of trade volatility and geographical diversification

As discussed in Section B, researchers interested in external sources of output volatility have typically used terms-of-trade volatility to proxy exposure to external risks. There are different measures of terms-of-trade volatility, each with its strengths and weaknesses. The most frequently used measure is the so called “barter terms of trade” from the WDI database. According to their definition: The "net barter terms of trade” are calculated as the ratio of the index of export prices to the corresponding index of import prices measured relative to the base year 2000. It is the relative price of the exportables in terms of the importables. This measure is only available from 1985 onwards.

Price indices are built on the basis of constant product baskets. The variability of this variable is thus in principle due to changes in the prices of traded goods. With a number of simplifying assumptions it can be shown that the variance of such a price index depends on the composition of the product basket and in particular on countries’ level of diversification. This is confirmed in Malik and Temple (2006), who find that product diversification stands out as the only strong predictor of terms-of-trade volatility.

The terms-of-trade variable captures changes in the aggregate price of exports or imports. A change in demand in some sufficiently large partner country would most likely induce a change in the terms-of-trade. A change in some small trading partner however may well leave the terms-of-trade unchanged. While terms of trade volatility only captures economic fluctuations that affect world prices, our measure of imported demand shocks also captures volatility in trading partners that does not affect world prices.

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We try to assess the role of exposure to external risk on income volatility using a panel regression. Previous literature has tended to use terms of trade volatility as a measure for external risk. We consider the following variables reflecting exposure to external shocks:

- Exposure to product price shocks. We use terms of trade volatility to take this source of external risk into account. According to Malik and Temple (2006), product diversification affects income volatility through its effect on terms of trade volatility.

- Exposure to country specific shocks in trading partners. The more geographically diversified our exports and the less volatile trading partners are, the lower the exposure to external demand fluctuations and the resulting volatility of our exports. This variable is measured by the Herfindahl index of geographical concentration or the “imported demand shock” index explained before.

- Openness: the more open, the more vulnerable to the two types of shocks mentioned above. On the other hand, openness may act as a buffer against internal shocks. The expected sign for openness is therefore ambiguous.\(^7\)

We also believe that GDP volatility depends on:

- GDP capita: richer countries with better institutions (e.g. financial) can diversify in capital markets. GDP per capita replaces to some extent institution variable in Malik and Temple (2006) and we expected wealthier economies to be less volatile.

- Population: the smaller a country the more likely that any type of shock affects per capita levels.\(^8\)

Using our panel data set we run the following regression:

\[ GDP_{i,t} = \beta_0 + \beta_1 TOT\text{vol}_{i,t} + \beta_2 IDS_{i,t} + \beta_3 (\text{CONTROL}) + u_{i,t} \]  

where \( TOT\text{vol}_{i,t} \) is the volatility of the barter terms of trade for country \( i \) at time \( t \) and \( \text{CONTROL}_{i,t} \) includes standard controls (oil-dummy, commodity-dummy, openness, population).

\(^7\) Openness is also correlated with country size, as smaller countries tend to be more open. This correlation also affects the results by Malik and Temple (2006).

\(^8\) Following Malik and Temple (2006) we use population at the beginning of the period in our regressions.
$IDS_{t,j}$ is our main variable of interest. It is supposed to capture countries’ exposure to shocks in foreign countries. $IDS_{t,j}$ is alternatively measures by geographical concentration and the imported demand shock measure that has been explained in the previous section. The assumed characteristics of $u_{t,j}$ depend on the estimation technique used.

Using panel data for the years 1985 to 2004 we first run our regression using the Herfindahl index for the geographical concentration of exports as a determinant of income volatility. Our measure of income volatility [GDPvol] is the standard deviation of the annual growth rate of real GDP per capita for the previous seven years. The GDP data are the chain weighted real output series [rgdpch] from release 6.2 of the Penn World Table and annual growth rates are measured using log differences. The results in this first exercise are disappointing. While terms of trade volatility performs well in all the regressions, the variable for geographical diversification is insignificant throughout.

| Table 1: Geographical diversification as a determinant of income volatility |
|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
|                            | regression 1                | regression 2                | regression 3                |
|                            | OLS                         | OLS with time dummies       | Fixed effects               |
| terms of trade volatility  | 0.048***                    | 0.054***                    | 0.028***                    |
|                            | (0.010)                     | (0.010)                     | (0.009)                     |
| Geographical diversification | 0.005                       | 0.004                       | -0.004                      |
|                            | (0.005)                     | (0.005)                     | (0.006)                     |
| Openness                   | 0.00001                     | 0.00001                     | 0.00006*                    |
|                            | (0.00001)                   | (0.00001)                   | (0.00006)                   |
| GDP per capita             | -8.92 e(-0.7)***           | -8.61 e(-0.7)***           | -1.10 e(-0.6)***           |
|                            | (9.62 e(-08))               | (9.73 e(-08))               | (1.84 e(-07))               |
| Population                 | -0.003***                   | -0.003***                   | -0.003°                     |
|                            | (0.0005)                    | (0.0005)                    | (0.002)                     |
| number of observations     | 1507                        | 1507                        | 1507                        |

***, ** and * refer significance at the 1, 5 or 10 per cent level respectively. ° 20 per cent significance

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9 Also the terms of trade volatility variable has been computed taking into account the changes over the previous seven years. The choice of seven years as a cut-off time is admittedly arbitrary and other cut-off points will be considered in future work.
In a second step we replace the Herfindahl index for geographical concentration, by our demand shock variable. The results change significantly. The measure for terms of trade volatility remains highly significant with the expected sign. Also the demand shock variable has the expected sign. It is significant at the one per cent level in the pooled regressions, at 10 per cent in the random effects regression and at 20 per cent in the fixed effect approach. Of the two approaches using the panel structure, the random effects regression is our preferred specification and the one most appropriate according to the results of the Hausmann test.

Table 2: explaining GDP volatility

<table>
<thead>
<tr>
<th>Regression 1</th>
<th>Regression 2</th>
<th>Regression 3</th>
<th>Regression 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terms of trade volatility</td>
<td>0.050***</td>
<td>0.055***</td>
<td>0.028***</td>
</tr>
<tr>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.009)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>Imported demand shocks</td>
<td>0.155***</td>
<td>0.138**</td>
<td>0.119°</td>
</tr>
<tr>
<td>(0.053)</td>
<td>(0.054)</td>
<td>(0.081)</td>
<td>(0.072)</td>
</tr>
</tbody>
</table>

Openness

GDP per capita

Population

Number of observations 1507

***, ** and * refer significance at the 1, 5 or 10 per cent level respectively. ° 20 per cent significance

When splitting the dataset in two according to the level of development of exporting countries, we see that the performance of the imported demand shock variable depends on whether exporters are developing or developed countries. Tables 3 and 4 report results only for the two variables we are most interested in.

Developing countries, i.e. non-OECD countries, represent the largest group in our sample. When we run our regression for these countries only, the terms of trade volatility variable behaves as in the regressions using the complete sample: it is significant at the one per cent level and has the expected
sign. The demand shock variable’s performance is weaker than in the previous regressions using the full sample. It has always the expected sign but is only significant at the 20 per cent level in the random effect regression, our preferred specification.

Table 3: Income volatility explained in developing countries

<table>
<thead>
<tr>
<th></th>
<th>regression 1</th>
<th>regression 2</th>
<th>regression 3</th>
<th>regression 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>OLS with time</td>
<td>Fixed effects</td>
<td>random effects</td>
</tr>
<tr>
<td>terms of trade volatility</td>
<td>0.049***</td>
<td>0.054***</td>
<td>0.028***</td>
<td>0.030***</td>
</tr>
<tr>
<td></td>
<td>(0.011)</td>
<td>(0.012)</td>
<td>(0.004)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>Imported shocks</td>
<td>0.155**</td>
<td>0.120*</td>
<td>0.100</td>
<td>0.100°</td>
</tr>
<tr>
<td></td>
<td>(0.061)</td>
<td>(0.062)</td>
<td>(0.086)</td>
<td>(0.077)</td>
</tr>
<tr>
<td>number of observations</td>
<td>1143</td>
<td>1143</td>
<td>1143</td>
<td>1143</td>
</tr>
</tbody>
</table>

The results are very different when we run the regressions for OECD countries only (Table 4). The imported demand shock variable is now highly significant in all four specifications and has the expected sign. The terms of trade volatility variable is now insignificant in the pooled regressions and only significant at the 20 per cent level—with the expected sign - in the fixed and random effects regressions.

Table 4: Income volatility explained in OECD countries

<table>
<thead>
<tr>
<th></th>
<th>regression 1</th>
<th>regression 2</th>
<th>regression 3</th>
<th>regression 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>OLS with time</td>
<td>Fixed effects</td>
<td>random effects</td>
</tr>
<tr>
<td>terms of trade volatility</td>
<td>-0.002</td>
<td>0.003</td>
<td>0.023°</td>
<td>0.019°</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.014)</td>
<td>(0.014)</td>
<td>(0.015)</td>
</tr>
<tr>
<td>imported shocks</td>
<td>0.450***</td>
<td>0.237**</td>
<td>0.363***</td>
<td>0.444***</td>
</tr>
<tr>
<td></td>
<td>(0.103)</td>
<td>(0.123)</td>
<td>(0.120)</td>
<td>(0.119)</td>
</tr>
<tr>
<td>number of observations</td>
<td>364</td>
<td>364</td>
<td>364</td>
<td>364</td>
</tr>
</tbody>
</table>
4. CONCLUSIONS

Using a panel approach we confirm the finding in the existing literature that terms of trade volatility has an impact on income volatility. When analysing developing countries and industrialized countries separately this result is confirmed for developing countries, but not for industrialized countries. As export diversification is known to affect terms of trade volatility, our results imply that product diversification affects income volatility in line with recent literature. But we find that the role of product diversification declines when countries become richer.

Recent literature has shown that countries diversify production as they grow richer, but that their production structure becomes increasingly concentrated after a certain threshold level of GDP per capita. Apparently wealthy countries can continue to do well with lower levels of product differentiation. Our results could be interpreted as being in line with this finding.

We developed a new index to reflect the amount of external fluctuations imported from trading partners. This index, called imported demand shocks, turns out to be an important determinant of income volatility. Diversifying exports over a larger set of trading partners and serving markets that are less volatile reduces imported fluctuations and smoothes own income volatility.

The relevance of the imported demand shock index is higher for OECD countries than for developing countries. Although our analysis does not allow us to make any conclusions with regards to causality and still needs some fine-tuning, our results may indicate that at early stages of development it is important for developing countries to focus on increasing the diversification of their exported product basket. When countries become richer they should focus on increasing the number export markets they serve and reducing their dependence on volatile export markets.

REFERENCES


