Over the Hedge

Exchange Rate Volatility, Commodity Price Correlations, and the Structure of Trade

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Abstract

A long empirical literature has examined the idea that, in the absence of hedging mechanisms, currency risk should have an adverse effect on the export volumes of risk averse exporters. But there are no clear conclusions from this literature, and the current consensus seems to be that there is at most a weak negative effect of exchange rate volatility on aggregate trade flows. However, most of this literature examines the impact of exchange rate volatility on aggregate trade flows, implicitly assuming a uniform impact of this volatility on exporters across sectors. This paper exploits the fact that, if exchange rate volatility is detrimental for trade, firms exporting goods that offer a natural hedge against exchange rate fluctuations—i.e.

those whose international price is negatively correlated with the nominal exchange rate of the country where they operate—should be relatively benefited in environments of high exchange rate volatility, and capture a larger share of the country's export basket. This hypothesis is tested using detailed data on the composition of trade of 132 countries at 4-digit SITC level. The results show that the commodities that offer natural hedge capture a larger share of a country's export basket when the exchange rate is volatile, but there is only weak evidence that the availability of financial derivatives to hedge currency risk reduces the importance of a sector's natural hedge.

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1 Introduction

A long literature has studied the impact of exchange rate volatility and exchange rate regimes on trade flows.¹ The initial motivation behind this literature was the idea that, in absence of access to hedging mechanisms, risk averse exporters would be adversely affected by currency risk and exports would be reduced (Clark (1973)). This simple mechanism rests on a series of assumptions and has been challenged both theoretically and empirically. Overall, the current consensus seems to be that there is at most a weak negative effect of exchange rate volatility on aggregate trade flows.

A shortcoming with most of the literature is the focus on the impact of exchange rate volatility on the aggregate volume of trade. From a theoretical perspective, what really matters for a trading firm is the volatility of its profits. How this volatility relates to the volatility of exchange rates depends on how this rate correlates with a firm's price and costs. In other words, what really matters for a firm is the volatility of its individual real exchange rate. For instance, Clark (1973) highlights the importance of the use of imported inputs as a natural hedge against fluctuations on the exchange rate. More recent papers also discuss the role of currency derivatives in reducing exposure to exchange rate risk (Wei (1999)).

Unless the prices and costs of all firms in a country are equally correlated with the nominal exchange rate, exchange rate fluctuations may have consequences for the composition of trade, even without having a large impact on the aggregate trade volume. This is consistent with recent empirical evidence showing that the impact of exchange rate volatility varies across broad groups of sectors. For instance, Broda and Romalis (2003), Clark et al. (2004), and Byrne et al. (2008) show that firms producing homogeneous goods tend to be relatively less affected by exchange rate volatility than firms producing differentiated products.

This paper studies the impact of exchange rate volatility on the structure of trade using detailed sectoral trade data. It starts from the simple premise that nominal exchange rate volatility should affect relatively less the trade of those firms and industries whose profits do not fluctuate much as a result of exchange rate movements. In particular, industries exporting goods whose international price co-moves negatively with nominal exchange rate fluctuations, which I refer to as industries with a *natural hedge* against exchange rate volatility, should be relatively less affected. Firms exporting goods with this characteristic are naturally protected against exchange rate risk. Therefore, if this risk matters they should be relatively less affected by exchange rate volatility.

The possibility that this natural hedge offers some protection to firms is supported by existing evidence that firms whose income is positively correlated with the exchange rate, such as those in

¹McKenzie (1999) surveys the traditional literature that used time-series methods to estimate the impact of a country's exchange rate volatility on its total trade and exports. The most recent literature has exploited detailed panel data on bilateral trade flows and used gravity equations to estimate the impact of exchange rate volatility, exchange rate regimes, and currency unions on bilateral or multilateral trade. See, for instance, Frankel and Wei (1993), Frankel and Rose (2002), Rose (2000), Rose and Van Wincoop (2001), Klein and Shambaugh (2006), and Tenreyro (2007), among others. Clark et al. (2004) provides a comprehensive recent survey.

more tradable sectors, have a higher fraction of foreign-currency denominated liabilities (Bleakley and Cowan (2008)). If this mechanism is empirically relevant, the structure of trade should naturally shift towards industries producing goods that offer a natural hedge against exchange rate fluctuations in countries with high exchange rate volatility, or as a result of sustained changes in exchange rate volatility such as those resulting from exchange rate liberalization. This is the hypothesis that is formally tested in this paper using data on the composition of exports of 129 countries across 749 commodities during 1984-2000, and the correlation of these commodities' global-unit-values and each of these countries' nominal exchange rates.

The idea that the price of some goods may be correlated with fluctuations in the nominal exchange rate has been present in the recent literature on commodity currencies (Cashin et al. (2004), Chen and Rogoff (2003)), which are currencies whose value fluctuates with the average price of the commodities exported by the country. Typical examples of commodity currencies are New Zealand and Australia. Because of this correlation, the price in local currency of these commodities and of any other sector whose price is correlated with them will be stable relative to other products. Thus, if fluctuations in the local currency price of goods matter for trade and resource allocation, firms in those sectors should become relatively more important after a sustained increase in exchange rate risk.

The importance of a commodity's natural hedge emphasized in this paper as a determinant of trade patterns may depend on the availability of other forms of hedging. For this reason, the paper controls for the availability of currency derivatives to assess the quantitative importance of the mechanism we emphasize. Moreover, in as much income uncertainty will impact financially constrained firms the most, one would expect that "un-hedged" exchange rate uncertainty will have a larger effect in countries with underdeveloped financial systems.

The results indicate that exchange rate volatility matters relatively more for those sectors that lack a natural hedge and are more exposed to it. The natural hedge against exchange rate volatility provided by a negative correlation between a commodity's international price and a country's nominal exchange rate affects its export patterns, even after controlling for other standard determinants of export composition, such as the factor content of trade and the export patterns of countries with similar income levels. An increase in exchange rate volatility from the 10th to the 90th percentile, corresponding to 57 percentage points, raises by 37 percent the ratio of the export share of a good at the 10th percentile of correlation (correlation of -0.55) relative to a good at the 90th percentile (positive correlation of 0.28). This difference is about 15 percent of the typical within-country difference in export shares across commodities. Larger differences in correlations are associated with proportionally larger changes in relative shares resulting from the same increase in exchange rate volatility. Without being a first order determinant of the structure of trade, this mechanism can explain a non-trivial portion of the observed differences in relative shares. Furthermore, instrumental variables specifications controlling for endogeneity suggest that the actual coefficient is likely one

order of magnitude larger, which would result in more meaningful quantitative impacts.

Similar results are obtained for the bilateral trade patterns across countries. For a given exporter-importer pair, an increase in bilateral exchange rate volatility raises the relative export share of a commodity with a large negative correlation. The magnitude of the effects is, however, quantitatively smaller, reaching only 10 percent of the typical differences in relative shares within a given country pair, which is not surprising considering the larger variability of bilateral trade shares.

There is also a positive relation between the natural hedge provided by a commodity's price movements and the growth rate of its total and bilateral export shares during the sample period. This relation can also explain about 10 percent of the typical differences in export shares growth. More importantly, when using the specification in growth rates to compute the long run impact of changes in natural hedge, the estimated coefficient is twice as large as when directly estimating the specification in levels, and accounts for a similarly larger share of differences in relative shares. In addition, similar results are obtained when comparing the role of natural hedging across exchange rate regimes instead of using an ex-post measure of exchange rate volatility. A commodity's natural hedge is related to its importance in a country's commodity basket mainly during flexible exchange rate regime periods. A series of robustness tests show that these results are not crucially driven by specific measures, countries, or commodities.

Somewhat surprisingly, the results show that the importance of a natural hedge against exchange-rate fluctuations is not clearly related to the availability of formal hedging instruments. Only when looking at the growth of export shares I find that a well developed market for foreign exchange rate derivatives weakens the relation between a commodity price's correlation with the country's exchange rate and its importance in the country's export basket in high exchange rate volatility environments. When looking directly at the composition of trade (in levels), the relation between the development of foreign exchange rate derivatives and the importance of natural share reverses. This is consistent with evidence by Wei (1999) that the availability of hedging instruments does not affect the relation between exchange rate volatility and trade. Broader measures of the development of financial markets do not seem to have such an effect on the importance of a natural hedge for export composition, suggesting that the relevant dimension of financial development for this mechanism, if any, is the widespread availability of exchange rate derivatives.

This paper relates to several strands of literature. First and most directly, it relates to the literature on the real effects of exchange rate volatility and exchange rate regimes (see, Frankel and Wei (1993), Frankel and Rose (2002), Rose (2000), Rose and Van Wincoop (2001), Clark et al. (2004), Klein and Shambaugh (2006), and Tenreyro (2007), among others; Clark et al. (2004) and McKenzie (1999) also provide comprehensive surveys of the pre- and post- gravity equation literature, respectively). It contributes to this literature by emphasizing the heterogeneity of the impact of exchange rate risk across industries and by focusing on its consequences for the composition

of trade.² Second, it also contributes to the literature on commodity currencies (Cashin et al. (2004), Chen and Rogoff (2003)) by emphasizing the implications that the comovement of nominal exchange rates with the price of goods has in terms of hedging of currency risk. Finally, this paper is also related to the empirical literature on the structure of trade that has explored the role of technology differences and factor endowments on the composition of trade (Leamer (1980), Romalis (2004), Fitzgerald and Hallak (2004), among others) by showing that factors besides these differences can influence the structure of exports.

From a policy perspective, the findings of this paper remind us of the endogeneity of the composition of exports, and show that it is affected by factors beyond standard relative factor abundance and that are related to the ability of firms to cope with the risks associated with exporting. If the composition of exports matters, as conjectured by Hausmann et al. (2007), addressing some of these financial market imperfections may be a way to move towards a first best export composition without engaging in industrial policy. However, the main caveat is that the results do not clearly show that the development of exchange rate derivatives weakens the relation between a sector's natural hedge and export composition. The results also highlight a potential channel between exchange rate liberalization and macroeconomic volatility. It has been shown that floating exchange rate regimes insulate output from terms of trade fluctuations (Broda (2004), Edwards and Levy Yeyati (2005)). However, since the results show that exchange rate flexibility increases export concentration by shifting activity toward sectors with a natural hedge, the stabilizing benefits of floating the exchange rate may be reduced because of a simple diversification argument.

The rest of the paper is structured as follows. Section 2 describes the methodological approach used to test the hypotheses that the natural hedge provided by some goods against exchange rate fluctuations increases the exports of sectors producing those goods vis-a-vis other sectors in countries with high exchange rate volatility, and that the extent of this advantage depends on the availability of formal sources of hedge for exchange rate risk. Section 3 describes the data sources and variables used. Section 4 presents the results of the paper and their robustness. Section 5 concludes.

2 Methodology

2.1 The composition of trade and exchange rate volatility

The empirical equations estimated in this paper are derived from a simplified version of Chaney (2008)'s version of Melitz (2003) model of trade with multiple goods and heterogeneous firms. This

²Within this literature, this paper is closely related to Byrne et al. (2008) who find a negative impact of exchange rate volatility in trade using data for 22 industries and six countries trading with the US. However, Byrne et al. (2008) does not consider relative sectoral prices to construct measures of sectoral exchange rate volatility because of the lack of high frequency data in the price deflators considered. As it will be discussed later, this paper makes assumptions about the covariances of prices at different frequencies to construct measures of the components of sectoral level exchange rate volatility.

model predicts that total exports from country i to country j of commodity h , $T_{i,j}^h$, are given by

$$T_{i,j}^h = \lambda_3^h \gamma_h \times \left(\frac{L_j}{L} \right)^{\frac{\sigma-1}{\gamma_h}} \times L_i \times \left(\frac{\theta_j}{\tau_{ij}^h} \right)^{\sigma-1}$$

where L_i and L_j represent the size of each country, L is total world size, θ_j is a measure of the importing country's remoteness, τ_{ij}^h captures bilateral trade resistance between the two countries and is commodity specific (this parameter will be later related to the volatility of exchange rate), and λ_3 , γ_h , and σ are technological parameters capturing the dispersion of productivity in a sector and the elasticity of substitution between goods in a sector, among other characteristics.

This expression can be integrated across several dimensions to determine a country's exports of a given commodity to the world, the world exports of a given commodity, and the total exports of a commodity to a given country. These aggregates will be used to characterize a country's composition of trade. For instance, a country's total exports of commodity h , $T_{i,W}^h$ are

$$T_{i,W}^h = \lambda_3^h \gamma_h \times L_i \times \tau_i^h,$$

where τ_i^h is a weighted average of bilateral trade resistance parameters τ_{ij}^h . Similarly, country i 's total exports are

$$T_{i,W} = L_i \times \tau_i,$$

with τ_i again a weighted sum of the commodity specific trade resistance parameters τ_i^h . This implies that the share of commodity h in a country's total exports, $X_{i,W}^h$, will be

$$X_{i,W}^h = \frac{T_{i,W}^h}{T_{i,W}} = \frac{\lambda_3^h \gamma_h \times \tau_i^h}{\tau_i}.$$

This expression can be used to obtain the following equation for the log total export shares

$$\log(X_{i,W}^h) = \delta_i + \delta_h + \log(\tau_i^h). \quad (1)$$

Proceeding in a similar fashion, one can derive an equation for the (log) share of commodity h in total exports from country i to j (bilateral export shares),

$$\log(X_{i,j}^h) = \log\left(\frac{T_{i,j}^h}{T_{i,j}}\right) = \delta_{jh} + \delta_{ij} + \beta \log(\tau_{ij}^h). \quad (2)$$

Transforming the expressions above into estimable equations requires specifying the form of the trade resistance terms at different levels of aggregation. This paper follows Tenreyro (2007) and

assumes that it is a parametric function of the volatility of the sector-specific real exchange rate:

$$\log(\tau_{ij}^h) = \nu_{ij} + \nu_h + \alpha VREX_{ij}^h,$$

with $VREX_{i,j}^h$ a measure of the volatility of product h 's real exchange rate between countries i and j . This is a simple, reduced-form, manner of capturing the possibility that a high degree of bilateral exchange rate volatility will affect trade between two countries.³ Analogously, I will assume that at an aggregate level, the multilateral trade resistance is parametrically related to product h 's real exchange rate relative to the world international prices

$$\log(\tau_i^h) = \nu_i + \nu_h + \alpha VREX_i^h.$$

Under these assumptions, expressions (1) to (2) can be transformed into the following estimable equations

$$\log(X_{i,W}^h) = \eta_i + \eta_h + \alpha VREX_i^h + \varepsilon_{ij}^h \quad (3)$$

$$\log(X_{i,j}^h) = \eta_{jh} + \eta_{ij} + \beta VREX_{ij}^h + \varepsilon_{ij}^h \quad (4)$$

2.2 Derivation of the volatility of the product level real exchange rate

Let R_i^h be the sector-specific real exchange rate of product h from country i vis-à-vis the dollar, computed as

$$R_i^h = \frac{e_{i,US} p_h}{p_i} \quad (5)$$

where $e_{i,US}$ is country i 's nominal exchange rate against the US dollar, p_h is the price of good h (in US dollars), and p_i is the country's price level (in local currency). The volatility of the growth or log-deviations from steady state of this sector-specific exchange rate is, therefore,

$$\begin{aligned} VREX_i^h &= \sigma^2(\hat{e}_{i,US} + \hat{p}_h - \hat{p}_i), \\ &= \sigma^2(\hat{e}_{i,US}) - 2Cov(\hat{e}_{i,US}, \hat{p}_i) + \sigma^2(\hat{p}_h - \hat{p}_i) + 2Cov(\hat{e}_{i,US}, \hat{p}_h), \\ &= \sigma^2(\hat{e}_{i,US}) - 2Cov(\hat{e}_{i,US}, \hat{p}_i) + \sigma^2(\hat{p}_h - \hat{p}_i) + 2\rho(\hat{e}_{i,US}, \hat{p}_h)\sigma(\hat{e}_{i,US})\sigma(\hat{p}_h), \end{aligned}$$

where the hats indicate growth rates or log deviations of a variable from its steady state value.

The expression above clearly shows that, at the sectoral level, real exchange rate volatility not only depends on the volatility of the nominal exchange rate but also on the volatility of relative

³In the model, τ_{ij} measures the fraction of the exported units that is "lost" during transportation. From the viewpoint of the exporter, uncertainty on the exchange rate may be seen as a transportation cost. An appreciation during transportation will reduce the amount of local goods that the exporter will be able to buy. Of course, the reverse argument also applies. Which one dominates ex-ante will depend on the degree of risk-aversion of the exporter. The specification above leaves the data speak about the sign and significance of α .

prices and on the comovement between these two. A good whose international price is highly volatile relative to domestic prices will face volatility in its international competitiveness even if there is no exchange rate volatility. Similarly, a good whose international price comoves negatively with the exchange rate will face less volatility in its real exchange rate than a good whose international price comoves positively with the nominal exchange rate.

It is the last covariance term in the expression above that I associate with the *natural hedge* of a good against exchange rate fluctuations, although in what follows I will also loosely use this term to refer to the correlation between the international price of a good and exchange rate fluctuations ($\rho(\hat{e}_{i,US}, \hat{p}_h)$), since this correlation determines whether the covariance term hedges or increases the exposure to exchange rate volatility. However, it is important to remember that what really matters is the whole covariance term. For a given correlation and exchange rate volatility, the intensity of hedging also depends on the variability of the international price of a good. For instance, the price of a good may have a large negative correlation with the nominal exchange rate, but if the price fluctuates little it will provide little hedging possibilities, even when the volatility of exchange rates is large.

Most existing papers on exchange rate volatility try to measure within-year volatility, because this higher frequency volatility is more likely to matter for ongoing production decisions.⁴ Measuring the within-year monthly volatility of the sectoral real exchange rates requires monthly data on sectoral prices, which is typically unavailable. To make use of the monthly data available for the nominal exchange rate I will assume that the correlation between nominal exchange rates and sectoral relative prices at monthly frequency is proportional to the correlation at annual frequency. I will also assume that the variance of the relative sectoral price at monthly frequency is proportional to the variance at annual frequency. These assumptions conjecture that there is not enough mean reversion to reverse the ranking of monthly volatility when moving at annual frequency. In the next section I will show these are reasonable assumptions using data from an alternative, more aggregated, data source. Under these assumptions, the within year variance of the sectoral real exchange rate can be written as

$$VREX_i^h = \sigma^2(\hat{e}_{i,US}) - 2Cov(\hat{e}_{i,US}, \hat{p}_i) + \gamma_0 \sigma_A^2(\hat{p}_h - \hat{p}_i) + \gamma_1 \rho_A(\hat{e}_{i,US}, \hat{p}_h) \sigma(\hat{e}_{i,US}) \sigma_A(\hat{p}_h) \quad (6)$$

where the subscript A denotes that the moment is computed using annual data, and the parameters γ are the proportionality coefficients for the relation between monthly and annual moments.

Substituting into equation (3) we obtain the following estimable expression that describes the

⁴This does not mean that lower frequency volatility does not matter, but that is likely to be more important for entry-exit decisions (see Caballero and Lorenzoni (2007)). The differential role of volatility at different frequencies has not been thoroughly studied and is an interesting direction for future research.

composition of the trade of country i with the rest of the world.

$$\log \left(X_{i,W}^h \right) = \theta_i + \theta_h + \alpha VAR_{i,h} + \beta CORR_{i,h} \times SDXR_i \times SDP_h + \gamma' Z_{i,h} + \varepsilon_{i,h}, \quad (7)$$

where the variables $VAR_{i,h}$, $CORR_{i,h}$, $SDXR_i$, and SDP_h are empirical measures of $\sigma_A^2(\hat{p}_h - \hat{p}_i)$, $\rho_A(\hat{e}_{i,US}, \hat{p}_h)$, $\sigma(\hat{e}_{i,US})$, and $\sigma_A(\hat{p}_h)$, respectively, and the first two terms in equation (6) are absent because they are absorbed by the country fixed-effect θ_i . The variables in $Z_{i,h}$ include other potential determinants of a country's trade structure that may be included as controls. As it follows from the discussion in the previous paragraph, the triple interaction term $CORR_{i,h} \times SDXR_i \times SDP_h$ measures good h 's natural hedge against exchange rate fluctuations, and β captures the importance of natural hedge. However, in the discussion below I will on occasion, and when not confusing, use the term *natural hedge* to refer only to the correlation component ($CORR_{i,h}$), understanding that for given volatilities of the exchange rate and international prices, it is the correlation that determines the level of hedging.

Similarly, the estimable equation for the composition of the bilateral trade with country j is given by

$$\log \left(X_{i,j}^h \right) = \theta_{ij} + \theta_h + \alpha VAR_{i,j,h} + \beta CORR_{i,j,h} \times SDXR_i \times SDP_{j,h} + \gamma' Z_{i,j,h} + \varepsilon_{i,j}^h. \quad (8)$$

where some of the variables have an extra sub-index that shows that the measure also varies with the importing country. For instance, while in the aggregate specifications p_h is the “global” price of good h , in the bilateral specification it is the price of good h in country j (which is the relevant price for countries exporting commodity h to country j). The main deviation from following the exact same steps as in the derivation of equation (7) is that the bilateral sectoral real exchange rates were computed using the US dollar as reference currency. The reason is that in the data prices in all importing countries are quoted in US dollars (see the detailed description of the data below), so instead of transforming the prices into local currency and transforming the pairs of nominal exchange rates against the dollars into a bilateral exchange rate, I directly used the dollar based data. Thus, in equation (8), $SDXR_i$ is also the standard deviation of the exporter's country nominal exchange against the US dollar, and $SDP_{j,h}$ is the standard deviation of the average price of good h in country j in US dollars, and $CORR_{i,j,h}$ is the correlation between these two variables. A caveat with this approach is that the triple interaction term in equation (8) is only part of the covariance between a country-pair's bilateral exchange rate and the price of a commodity in the importing country in local currency. The other part corresponds to the covariance between the exchange rate against the dollar of each of the countries in the pair, which is non-parametrically absorbed by the country-pair fixed effect $\theta_{i,j}$.⁵

⁵Notice also that while equation (4) has a non-parametric importing country-sector fixed effect (η_{jh}), this specification has only a sector fixed effect (η_h). The justification of this substitution is reducing computing time. In the

2.3 Measurement and other issues

The variable $CORR_{i,h}$ is the time-series correlation between good h 's international (or bilateral) price (in US dollars), $\hat{p}_{h,t}$, and country i 's nominal exchange rate (local currency per US dollar), $\hat{e}_{i,t}$, computed as

$$CORR_{i,h} = \frac{\frac{1}{T_{i,c}} \sum_t (\hat{p}_{h,t} - \bar{p}_h)(\hat{e}_{i,t} - \bar{e}_i)}{\sigma(\hat{p}_{h,t})\sigma(\hat{e}_{i,t})},$$

where the notation follows from above. In what follows, the term *correlation* and the variable $CORR$ will be used to refer to this particular correlation measure, unless explicitly stated otherwise. The bilateral correlation $CORR_{i,j,h}$ is computed analogously, replacing commodity h 's global price by the price in importing country j .

The volatility of nominal exchange rates is captured by their average within-year standard deviation, $SDXR$,

$$\begin{aligned} SDXR_{i,t} &= \sqrt{\frac{1}{12} \sum_{m=1}^{12} (\hat{e}_{i,t,m} - \bar{e}_{c,t})^2}, \\ SDXR_i &= \frac{1}{T} \sum_t SDREX_{i,t}. \end{aligned}$$

The variance of relative prices and the standard deviation of a commodity price are computed using annual data, since monthly data is unavailable at high levels of disaggregation:

$$\begin{aligned} VAR_{i,h} &= \frac{1}{T} \sum_{t=1}^T \left((\hat{p}_{h,t} - \hat{p}_{i,t}) - \overline{(\hat{p}_h - \hat{p}_i)} \right)^2 \\ SDP_h &= \frac{1}{T} \sum_{t=1}^T (\hat{p}_{h,t} - \bar{\hat{p}}_h)^2 \end{aligned}$$

and the term $CORR_{i,h} \times SDXR_i \times SDP_h$ in equations (7) and (8) denotes the interaction of these three variables and is the broad measure of the *natural hedge* provided by a good in a given country (or country-pair). According to the hypothesis that goods with natural hedging are relatively benefited in more volatile environments, the coefficient on this interaction, β , should be significantly negative. The specification includes good and country fixed effects, denoted by θ_h and θ_i , respectively, and in the bilateral specification it includes country-pair fixed effects $\theta_{i,j}$ that control for the fact that

estimations below, the country-pair fixed effects (θ_{ij}) are not estimated but properly removed from the estimation by properly “de-meaning” the data. A set of importing country-sector fixed effects would not be orthogonal to the country-pair fixed effects and would have to be directly estimating, making the estimation extremely slow. I checked the results with the full set of fixed effects described in (4) for the baseline specification, obtaining estimates of β that are quantitatively and statistically similar to those obtained in this simplified version of the specification. The results are available upon request.

some goods are more heavily traded than others and that some countries (or pairs of countries) trade relatively more and in more goods than the average.

The vector $Z_{i,c}$ includes all potential determinants of a country's trade structure that need to be controlled for, in particular, the role of countries' factor intensity in shaping its trade patterns. Standard trade models predict that countries should export relatively more those goods that are intensive in its abundant production factors (Heckscher et al. (1991)). Although this prediction has received mixed empirical support (Leamer (1980), Romalis (2004), Fitzgerald and Hallak (2004), among others), it is important to control for it by adding the interaction of measures of the factor intensity of a good and a measure of the factor abundance of a country, to avoid wrongly attributing to exchange rate volatility the role of differences in factor abundance. Therefore, the empirical specification in equation (7) could be considered as an extension of the quasi-Heckscher-Ohlin model estimated by Romalis (2004), that adds the possibility that natural hedge may distort trade patterns beyond those explained by factor content. In this sense, it is also similar to the reduced form relation between sectoral output and endowments capturing the intuition of the Heckscher-Ohlin model estimated by Fitzgerald and Hallak (2004) to explain output composition among OECD countries.

Since there is no data on factor intensities for the broad set of goods considered in this paper, I construct a rough estimate of the factor intensity of a good by using *actual trade patterns* to compute the trade weighted average of the factor abundance of the countries that export it.⁶ Under the assumption that trade patterns reflect differences in factor abundance, this measure would be akin to a revealed measure of factor intensity. If countries that are relatively abundant in a factor tend to concentrate a larger fraction of their exports in goods that are relatively intensive in the use of that factor, a revealed measure of factor intensity of commodity h for factor F , $\phi_h(F)$, can be built from the within-country composition of trade, as

$$\phi_h(F) = \frac{\sum_i X_{i,W}^h \Phi_i(F)}{\sum_i X_{i,W}^h},$$

where $\Phi_i(F)$ is country i 's relative abundance of factor F , and $X_{i,W}^h$ are the total export shares described above. Three measures of factor intensity are built using this procedure, capturing skilled labor intensity, capital intensity, and resource intensity. Following Romalis (2004), I also use GDP per capita as a measure of overall factor abundance. Also following Romalis (2004), the country level factor abundances $\Phi_i(F)$ are taken from Hall and Jones (1999) and from the World Bank (2008) but instead of expressing factor intensities relative to the US, they are expressed relative to the world average. The reason is that while Romalis (2004) tries to explain bilateral exports to the US, this paper focuses on a country's trade with the rest of the world. Notice that, when applied to the output per capita of different countries instead of their factor endowments, this measure

⁶Romalis (2004) measures factor intensity directly from US Census of Manufactures (1992), but this would seriously constrain the set of goods that can be considered.

corresponds to the *PRODY* measure introduced by Hausmann et al. (2007).

Using these “revealed” factor intensity measures departs from the structure imposed by standard trade models on the coefficients of the Heckscher-Ohlin equations, but it has the advantage of providing a broader, more agnostic description of trade patterns. It recognizes that, for whatever reason, some goods are typically more intensively traded by countries that are, for instance, more abundant in skilled labor, without taking a stance on whether this is due to factor endowments only or to a combination of endowments with technological differences. Since this paper does not aim to document the validity of different models of trade, but to test for the role of natural hedge in the most general way, this agnostic approach is sensible.⁷

The main concern with the specification described in equation (7) is the possibility of reverse causality. The argument for reverse causality is that a country’s nominal exchange rate may endogenously appreciate with an increase in the price of goods that represent a large fraction of a country’s exports, inducing a negative correlation between a country’s nominal exchange rate and the price goods it exports the most. This reverse mechanism would only affect the correlation of a country’s exchange rate with the price of different goods and not the volatility of the exchange rate, but it is more likely to be strong when a country has a flexible exchange rate regime where the volatility of the exchange rate is likely to be higher. Therefore, the argument cannot be dismissed on these grounds. Nevertheless, there are two aspects of the specification that should ease these concerns. First, the mechanism relates the price each country gets from its most exported goods to its nominal exchange rate, but the estimated international price used in this paper is a world average of individual prices. As it will be described below, these individual prices suffer important variation across countries, so the mechanic relation with the international price is less likely. Second, this argument is much weaker for bilateral trade patterns. An increase in the price paid for a commodity by a single trading partner is unlikely to affect the bilateral exchange rate between the exported and importer, which is determined in a global equilibrium.

Despite these departures from a mechanical reverse relation between export shares and correlations, it may still be the case that the correlation between global and country prices, or between global and bilateral shares are particularly strong for homogeneous goods. This concern implies that the estimated relation should be significantly stronger among homogeneous goods, so it can be addressed by comparing the coefficients obtained for homogeneous and differentiated goods. Furthermore, the importance of reverse causality can be further addressed by restricting the estimation to only those goods that do not represent a large share of a country’s exports (e.g. below 10 percent). Finally, it is also possible to tackle this concern directly through instrumental variable estimation. A potential instrument for the correlation between the international price of a good

⁷I also considered an alternative measure that weighted country level factor abundances by the share of a country’s in a commodity global trade instead of the within country shares. The results described below are robust to this alternative choice, but these revealed measures exhibited less variability across goods because larger countries tend to grab a relatively large world share of the exports of most products.

and the exchange rate of a country vis-a-vis the dollar is the correlation between the price of that good and the value of the dollar in international markets vis-a-vis other major currencies.

2.4 Stationary versus transition equations

The empirical specifications in equations (7) to (8) describe the long run equilibrium of a country's trade pattern, conditional on other characteristics. Since the force that leads sectors with natural hedge to become more prevalent in more volatile environments probably operate over long periods, this is an accurate representation of the long run steady state composition of exports. However, since the available trade data covers at most 17 years, during which many countries engaged in structural reforms that might have affected the steady state composition of exports, such as trade liberalization, from an empirical perspective it may be also appropriate to estimate the transitional version of the equation that relates natural hedge to the growth of the export share of a commodity over the sample period, given by,

$$T^{-1}\Delta \log \left(X_{i,W}^h \right)_{t,t+T} = \theta_i + \theta_h + \eta \log \left(X_{i,W}^h \right)_t + \alpha VAR P_{h,i} + \beta CORR_{i,h} \times SDX R_i \times SDP_h + \gamma' Z_{i,h} + \varepsilon_{i,h}, \quad (9)$$

where the notation is as above, except that $T^{-1}\Delta \log \left(X_{i,W}^h \right)_{t,t+T}$ is the average growth rate of the global export share during the sample period of length T , and $\log \left(X_{i,W}^h \right)_t$ is the (log) initial value of this share for each country-good pair. The long run, stationary equilibrium of this equation corresponds to equation (7), where the long run coefficients correspond to the short run ones divided by $-\eta$. The long run coefficient associated with the interaction would, therefore, be $(-\beta/\eta)$. A similar transition equation applies to the bilateral export shares model of equation (8).

In addition to allow for non-stationarity, this specification is also less likely to be affected by the reverse causality problem discussed above, since it controls for initial size differences across sectors and convergence effects. Finding similar evidence on growth rates would strongly support the view that it is the natural hedge offered by the correlation that favors certain sectors.

3 Data

Data on export composition come from Feenstra et al. (2005), NBER-UN World Trade Flows database, which reports bilateral trade flows (imports and exports) for a large number of countries at detailed 4-digit SITC (Revision 2) level during the period 1962-2000. This database has been broadly used in the empirical trade literature, specially in the estimation of gravity models of disaggregated trade (Chaney (2008), Colacelli (2008), Do and Levchenko (2007)). Because of restrictions to the availability of other variables, the analysis focuses on the 1984-2000 period. Our final sample includes

129 countries and 749 goods, after dropping some regions and countries with limited coverage or no mapping with exchange rate data and special SITC codes used by Feenstra et al. (2005) to make 4-digit flows compatible with 3-digit values. In particular, all countries exporting less than 10 4-digit SITC commodities and all commodities exported by less than 10 countries are excluded, as well as the US, which is the country of the anchor currency. Country-commodity pairs where the correlation between international prices and exchange rates was constructed using less than 8 annual observations or those with a correlation larger than 0.9 (in absolute value) were also dropped. Using this dataset the export shares of a country in different goods was constructed as described in the previous section. The countries included in our main sample as well as their average exports at SITC level, and number of goods exported are reported in the appendix.

The international price of a good $P_{i,t}$ is measured by its global unit value, using data on total values and quantities exported across the world, also from the Feenstra et al. (2005) database,

$$P_{i,t} = \frac{V_{i,t}}{Q_{i,t}},$$

where $V_{i,t}$ is the total value of global gross exports of good i , and $Q_{i,t}$ is the total global quantity exported (in tons). The price index built in this manner corresponds to a quantity weighted average of country-level unit values.

Despite its simplicity and wide availability there are several shortcomings in using unit values as measures of international prices, most importantly that they do not control for changes in quality. Thus, an increase in the quality of goods could result in an increase in unit value that should not be captured by an ideal price index that controls for the characteristics of a good. However, since this paper focuses on global unit values, this would not be a problem if the average quality of traded goods across the world does not change significantly. Although there is no evidence on this regard, the average quality of exported goods is more likely to be stable than the quality of individual country exports, as during the life-cycle of a good, production of the cheapest varieties shifts to poorer countries. The concerns about quality differences are also reduced by using a highly disaggregated classification, which is the motivation for working with the lowest level of aggregation reported by Feenstra et al. (2005). Also, problems with the level of unit values should not affect this measure because this paper focuses on the correlation between the growth rate of these global unit value indexes and the growth of the nominal exchange rates of different countries. Differences between the growth of this index and that of the actual price of goods exported by a country within an SITC class may arise from differences in the growth of the quality of a country's exports relative to global exports. However, these differences would only introduce measurement error that would make it less likely to find any significant result.

A more pragmatic reason to use fluctuations in global unit values as proxies for price fluctuations

is that there are no better detailed comprehensive choices available.⁸ The Bureau of Labor Statistics (BLS) reports data on import and export price indexes for the US, but these indexes are available only at a fairly aggregate level: 129 commodities overall, and only 72 commodities at 3-digit SITC (Rev 3). Furthermore, the BLS indexes are reported using the third revision of the SITC, while the trade data described above use the second revision. Imputing BLS prices to trade data requires a concordance between these two classifications. Since the concordance is not one to one (a 4-digit sector from SITC Rev 2 may belong to more than one 3-digit sector in Rev 3), the number of well mapped sectors would be even smaller. Working at this level of aggregation would miss the point of the paper that exposure to exchange rate risk varies across sectors. Nevertheless, to ease concerns and provide some further validation to the use of global unit values as proxies for prices, I computed the global unit values for 70 commodities that have BLS price data and where there was a clear map to SITC Rev 2 commodities and checked the within-commodity across-time correlation between the two price series by running a fixed effect regression between the growth rates of prices from the two sources. Although the time span is short because BLS data are available only since 1993, the regression shows a positive and highly significant relation between the two series. The results are summarized in the two plots reported in Figure 1 that show the partial regression between the two price growth series for the whole sample, and dropping the extremes. Each scatterplot also reports the estimated coefficient in each subsample and shows that both relations are highly significant. This evidence suggests that, despite their shortcomings, fluctuations in global unit values are good proxies for fluctuations in international prices.

The BLS data also shed some light on the validity of the assumption that the correlation between nominal exchange rate growth and the growth of the sectoral prices at monthly frequency is proportional to the correlation at annual frequency. Using the monthly BLS data it is possible to compute and compare the correlations at monthly (within year) and annual frequency, as well as the variance of relative prices ($\hat{p}_h - \hat{p}_i$) and the standard deviation of sectoral prices ($\hat{p}_h$) at these two different frequencies. The results, summarized in Table 2, show that, within a country, the correlations, variances, and standard deviations at these two different frequencies are positively and significantly related. Not surprisingly, the weakest relation is for the correlation measures, where the relation between the within and across year measures is significant only at the 2 percent level. It is also the case that all the estimated coefficients are much smaller than 1, which suggests that the coefficients of the specification described in equation (7) estimated using annual frequency proxies will be smaller than the true coefficients associated with the within year measures of correlations, variances, and standard deviations. Furthermore, it is clear from the figure that the relationship between annual and monthly correlations, while significant, is imprecise and annual correlations explain only a fraction of monthly correlations (R^2 is only 0.05). This means that the annual proxies

⁸I attempted using US import price indexes from BLS as an alternative, but doing so significantly reduces the number of goods covered because of a higher level of aggregation and to an imperfect match between BLS sectors (based on SITC rev 3) and Feenstra sectors (based on SITC rev 2).

may have important measurement error, leading to attenuation bias in the estimated coefficients. This should be considered for the quantitative interpretation of the results below.

Data on nominal and real effective exchange rate at monthly and annual frequencies come from the International Monetary Fund 2008, and data on the development of foreign exchange derivatives in different countries, measured by the ratio of average daily turnover to total GDP and total exports come from the Bank of International Settlements (1998, 2001, 2004, and 2007) Triennial Survey of Central Banks. Since this survey is conducted only every three years, the average value across available years is considered as representative country value. Data on a country's degree of financial development come from Beck et al. (2000) (2006 revision).

The correlation between the annual growth of different international good prices and the growth of the nominal exchange rates of the countries in our sample was computed as described in section 2, using the data detailed above. This procedure yields a matrix of estimated correlations where each row corresponds to a 4-digit SITC good, each column corresponds to a country, and each entry is the estimated time-series correlation between the growth rate of the price of the good described in the row and the country described in the column. The distribution of the estimated correlations is shown in Figure 2. It shows that while the correlations cover a broad set of values, the mass of the distribution is shifted to the negative side. There are 57484 correlations in the database across 129 countries and 749 commodities with available data. Since our sample covers at most 17 observations, most of the estimated correlations are not statistically significant, in fact only 22 and 32 percent of the estimated correlations are significantly different from zero at the 10 and 20 percent level, respectively. This introduces an additional source of noise that should make even more difficult finding any significant result.

The 20 country-good pairs with the most positive and negative correlations are reported in Table 1. The commodities are distributed across many countries. For instance, the 20 commodities-countries with the most negative correlations are distributed across 12 countries and 18 commodities, and the 20 with the largest positive correlation are distributed across 15 countries and 17 commodities. In each group, the commodities cover a wide variety of industries. Figure 3 shows that this variation is a robust pattern of the data. The average correlation across commodities within countries (Panel A) fluctuates between -0.4 and 0.4. As expected from the histogram, the average correlation is negative in most countries, but there is a sizable number of countries where it is positive and there is no individual country that stands as an outlier. The same applies to the distribution of average correlations across countries within commodities (Panel B). This suggests, as it is indeed the case, that the results reported below are robust to dropping any particular commodity and country.

4 Results

This section presents and discusses the results of the estimation of the empirical specifications described in equations (7), (8), and (9) that test for the qualitative and quantitative importance of a sector’s natural hedge for a country’s export structure. It first presents the baseline results in levels and growth rates, addresses several concerns about these specifications through a battery of robustness tests, and explores the role of the availability of formal financial hedging instruments for exchange rate risk.

4.1 Baseline results

Countries with higher nominal exchange rate volatility tend to export relatively more goods whose international price is negatively correlated with their exchange rate fluctuations, especially when this price is also volatile. This is shown in the different columns of Table 3. Panel A shows the estimated coefficients for three versions of equation (7) that include only the interaction of *CORR*, average exchange rate volatility, and average price volatility $CORR \times SDXR \times SDP$, and that sequentially adds controls for factor content and product differentiation. In all regressions, the coefficient on the interaction, β , is negative and statistically significant.

The economic magnitude implied by the coefficient is small but meaningful. Since the coefficient on natural hedge is akin to a diff-in-diff estimator, a useful way to gauge its quantitative importance is to conduct a counter-factual experiment of what would be the change in relative export shares of different commodities resulting from an increase in volatility. Let s^{10} and s^{90} be the export shares of the good at the 10th and 90th percentile of correlation, respectively. An increase from the 10th to the 90th percentile in the combined volatility of nominal exchange rate and international prices ($SDXR \times SDP$) would raise s^{10}/s^{90} , the ratio of the export share of a good at the 10th percentile level of correlation (correlation of -0.55) relative to the share of a good at the 90th percentile of correlation (correlation of 0.28), by 45 percent. This is about 20 percent of the standard deviation of relative shares (s^{10}/s^{90}).

Alternatively, to gauge only the importance of exchange rate volatility, one can keep the volatility of international prices at its average level and repeat the counter-factual. In this case, an increase in exchange rate volatility from the 10th to the 90th percentile raises by 37 percent the ratio of the export share of a good at the 10th percentile level of correlation relative to a good at the 90th percentile, which corresponds to 15 percent of the standard deviation of (log) export shares. Of course, the relative differences are larger when comparing commodities with larger differences in natural hedge. Similar increases in combined volatility and in exchange rate volatility result in relative increases in export shares of 32 and 26 percent of the standard deviation of relative shares when comparing commodities with correlations of -0.7 and 0.7. Therefore, according to the estimates, changes in natural hedge could induce changes in relative shares of about one-

fifth of the within-country dispersion of export shares. While not a first order determinant of export composition, the mechanism is quantitatively meaningful. Furthermore, as discussed above, measurement error in the use of annual correlations and variances to proxy for their within-year counterparts, as well as the evidence from BLS price data that the within-year measures have less dispersion than their annual counterparts, suggest that the true coefficient for the correlation in equation (7) may be larger than the ones reported in Table 3. Therefore, it is likely that these quantitative impacts are a conservative estimate of the true economic relevance of this mechanism.

Bilateral regressions show similar results. The coefficient is also significantly negative across specifications. In this case, an increase in the volatility of a country's exchange rate against the US dollar from the 10th to the 90th percentile (75 percentage points increase) raises by 20 percent the ratio of the export share of a good at the 10th percentile level of correlation (-0.65) relative to a good at the 90th percentile (0.29) (measured at the average level of price volatility). This corresponds to 11 percent of the average within country-pair standard deviation of log export shares. Comparing hypothetical commodities with correlations of -0.7 and 0.7 yields a 30 percent increase in the relative export share of the former, corresponding to 16 percent of the within country-pair variation of relative shares. This smaller explanatory power is not surprising since the term included in the regression is only part of the actual covariance between bilateral exchange rates and importer's prices, the other term being the covariance between the importer and exporter exchange rates against the dollar, which is absorbed non-parametrically.

Overall, the results for the baseline specification indicate that differences in natural hedge across commodities have a small but non-negligible impact of natural hedge on trade patterns. This is encouraging considering the typically poor fit of Heckscher-Ohlin regressions.

The results presented in columns (2), (3), (5), and (6) show that the measures of revealed factor intensities matter for trade patterns. Column (2) introduces the interaction of the baseline measures of factor intensity with a country's measure of factor abundance. The regression in Column (3) replaces these interactions by the interaction of the measure of the overall factor intensity of a commodity and a country's relative output per worker, which is a measure of a country's overall factor abundance (see Romalis (2004)). This measure is also the *PRODY* measure introduced by Hausmann et al. (2007) and controls in a general way for the possibility that richer countries tend to export similar products, beyond what can be explained by relative factor endowments. The results of these two columns show that, in fact, countries tend to concentrate a relatively larger fraction of their exports in goods that are intensive in their more abundant factors. All estimated coefficients are positive and statistically significant, except for the one for capital intensity in Column (2), but the sign and significance of the main coefficient remain unaffected. There is, however, a decline in the magnitude of the main coefficient in the regressions for global trade shares, which is about half the size of the baseline when controlling for overall factor intensity in column (3). Part of this decline is due to the smaller sample of countries for which there are data on the factor endowments.

There is no such decline in the regressions explaining bilateral trade patterns.

Adding these other controls also permit comparing the economic magnitude of the natural hedge coefficient with that of other determinants of trade patterns. I use the same approach described above of comparing the impact of an increase in a country level variable on goods at the 10th and 90th percentile of the distribution of a variable to quantify the impact of the measures of factor intensities. The impact of natural hedge on trade composition is 16 percent of that of skill intensity, 80 percent of that of capital intensity, 61 percent of that of resource intensity, and 10 percent of that of overall factor intensity. Therefore, the economic size of the natural hedge mechanism is smaller, but in most cases of the same order of magnitude of other significant determinants of trade patterns.

Estimating the growth version of equation (7) presented in equation (9) allows dealing with non-stationarity, which may be appropriate considering the length and time period of the data, and also reduces concerns about reverse causality between the export share of a good on a country and the correlation of that country's exchange rate with the price of the good (more on this below). Table 4 reports the results of estimating the same regressions presented in both panels of Table 3, but in growth form instead of levels. The evidence is clear and the results are stronger than those in levels, easing the concerns that the bulk of the previous findings could be due to reverse causality (more on this below). The estimated coefficients for β are negative and statistically significant regardless of whether the share of exports represented by a good is measured within or across countries. According to the estimated coefficients, an increase from the 10th to the 90th percentile in the volatility of exchange rate, would increase in three percentage points the growth rate of the export share of the sector at the 10th percentile of correlations relative to that of the sector at the 90th percentile. This is about 10 percent of the typical differences in growth rates of export shares across sectors.

In the growth equation, the magnitude of the natural hedge coefficient is also large compared with the economic effect implied by the coefficients associated with other determinants of trade composition, which are in most cases statistically insignificant. For instance, an increase from the 10th to the 90th percentile in either the country level of skills or capital per worker would increase the difference in growth rates of sectors at the 10th and 90th percentile of revealed skill intensity in about three percentage points; about the same impact of natural hedge computed at the mean level of commodity price volatility. Only the coefficient associated with overall factor abundance has a larger economic impact three times larger than that of natural hedge, although not statistically significant. Thus, the natural hedge mechanism is not only statistically significant, but also has a similar economic impact as that of more standard determinants of trade.

It is also possible to use the estimated coefficients to gauge the long run relation between natural hedge, exchange rate volatility, and trade composition. As mentioned in section 2, the long run coefficient associated with the main interaction is $(-\beta/\eta)$. The value of this coefficient, and

its standard error are reported at the bottom of the table. The coefficient is about twice as large as that obtained in the levels equation, and it implies that an increase in exchange rate volatility from the 10th to the 90th percentile would result in a relative share increase of about 82 percent, which is about 34 percent of the typical variation in relative shares across industries. Of course, the relative comparison with other determinants of trade is the same as in growth rates.

4.2 Reverse causality issues

The concern about reverse causality is addressed in the regressions reported in Table 5. As a reminder, the concern is that changes in the international price of goods that capture a high share of exports could put pressure on the nominal exchange rate. This is what the commodity currency argument has in mind, and could induce a negative correlation between the price of a country's main exports and its nominal exchange rate. As argued above, the use of an average international price index for each good instead of a country specific price should ease concerns. However, the concern remains if there is little variation in the price paid to different countries for a given good. This is most likely to be the case for homogeneous goods that have a well defined international price. Thus, the regressions in columns (1) and (2) separately estimate the baseline specification for differentiated and homogeneous goods, respectively (defined according to Rauch (1999) classification).

The results show that the findings are not driven by homogeneous goods, and in fact, the results are stronger among differentiated goods. Considering total export shares, the natural hedge coefficient is even positive among homogeneous goods, although very imprecisely estimated. Considering bilateral export shares the coefficient for homogeneous goods is slightly smaller than for differentiated goods, but also insignificant. Since international prices of differentiated goods are not mechanically related to an individual country's terms of trade, this should ease concerns about the role that an increase in the prices of heavily exported goods has on the nominal exchange rate. These results are also consistent with those of Broda and Romalis (2003), who find that exchange rate volatility mattered mainly for differentiated goods.

Another way of tackling the reverse causality issue is to exclude from the estimation those goods that represent a sizable share of a country's exports. The mechanism behind the reverse causality issue is roughly that an increase in the price of an exported good increases the local supply of dollars, putting pressure for a nominal appreciation. While this is plausible in countries that have large and very concentrated exports (e.g. commodity exporters), this macroeconomic effect is unlikely to occur for goods that represent a small fraction of a country's exports. To check for this, the regressions in columns (3) to (5) sequentially drop from the sample those goods with average export shares above 10, 5, and 1 percent. The main coefficient remains largely unchanged. Finally, the regression in Column (6) reproduces the baseline specification using a country's share of global commodity exports in each commodity. That is, instead of measuring the importance of a commodity relative to a country's total exports, this regression measures the importance of a country's exports of a

commodity relative to the global exports of that commodity. This specification can be easily derived in the same way that equation (7) was derived in section 2. Since a commodity may be important for a country without necessarily representing a high share of global trade in that commodity, this specification should be less affected by the reverse causality mechanism. The results again show a significantly negative relation between natural hedge and global export share of a commodity.⁹

Finally, the best way of addressing any concern of reverse causality is to use instruments. Of course, the challenge is to find relevant exogenous instruments. The regression in Column (7) show the results obtained instrumenting the correlation between a goods' international price a country's nominal exchange rate by the correlation observed for that good in the UK, France, and Japan. These instruments should capture global movements in the value of the dollar vis-a-vis major currencies, and, therefore, are not affected by the relation between individual country's main export price and its exchange rate. The triple interaction associated with the natural hedge is then instrumented by the interaction of the correlations in each of these three countries and the product of a country's exchange rate volatility and a commodity's price volatility. These IV regressions were only conducted for the global trade share specification (Eq. [7]) because the instruments capture the correlations resulting from global fluctuations of major currencies against the dollar and cannot explain the bilateral dimension of the correlations. In any case, as discussed above, the reverse causality argument does not clearly apply to bilateral trade shares.

The results yield supportive evidence for the presence of a causal link between natural hedge and export composition. The coefficient for the interaction of correlation and exchange rate volatility is negative, statistically significant, and an order of magnitude larger than those reported in Table 3. The instruments are valid according to the Hansen J-statistic (see the p-value of this test at the bottom of the table) and they are not weak: the F statistic of the first stage regression is 55, and the hypothesis that the actual size of the nominal 5 percent test is larger than 5 percent is rejected based on the Kleibergen and Paap (2006) LM statistic and the Stock and Yogo (2002) empirical distribution for the Cragg-Donald statistic. Similar results are obtained for the regression including the factor endowments, although the coefficients for the factor endowment are similar to those obtained by OLS. Interestingly, the coefficient for the variance of real commodity price is now negative and significant.

These results, and the discussion above on the role of measurement error and the use of annual moments instead of within-year ones, indicate that the true relevance of natural hedge for the composition of exports may be significantly higher than that obtained in the baseline OLS estimation, and that the OLS coefficient could be considered a lower bound on the true importance of natural hedge. This reinforces the view that the mechanism is quantitatively relevant.

Overall, these results indicate that concerns for reverse causality are not behind the qualitative findings of the paper. Together with the evidence on growth rates that is not mechanically affected

⁹Of course, the global shares concept cannot be replicated at the bilateral level.

by this problem, this strongly support the view that differences in natural hedge matter for the composition of a country's exports.

4.3 Robustness

The baseline results were obtained measuring the correlation of the international prices and nominal exchange rates, as well as the volatility of the exchange rate using the growth rates of each series to remove trends. Under the assumption that the series are difference stationary (in logs), this procedure correctly removes trends, but it may still lead to spurious correlations if the growth rates are trending, which could happen over short periods of time. An alternative procedure would be to de-trend the series by filtering their long run trends using a Hodrick-Prescott filter (HP filter). This more complex detrending procedure allows for changes in the low frequency trends followed by the series.¹⁰ To check for the importance of the choice of detrending procedure I also estimated the regressions for the global share specification (Eq. [7]) using standard deviations and correlations computed from HP filtered series.¹¹ The results, reported in Table 6, are somewhat smaller but very much in line with those obtained in the baseline regressions, both in sign and magnitude.

A potential concern with the results is that extreme and potentially unreliable observations for the correlation may be behind the findings. The baseline sample already dropped country-industries with correlations larger than 0.9 in absolute value, with correlations computed using too few annual observations (less than 8), as well as countries that exported too few goods and industries exported by few countries. Still, to check the role of extreme observations, the regressions in Table 7 impose further constraints on those variables. Column (1) drops country-industries with correlations above 0.8 (in absolute value), Column (2) drops those computed with less than 12 annual observations, and Column (3) drops sectors exported by less than 20 countries and countries that export less than 20 goods. As before, the results are largely unaffected.

The findings are not crucially driven by individual countries or goods. This is shown in Figure 4 that present histograms of the values for the main coefficient β obtained after dropping one country and one good at a time from the sample, respectively. The figure presents five histograms. Panels A and B show the histogram of the coefficient for the regression with global export shares as dependent variable after dropping one exporting country (Panel A) and one industry (Panel B) at a time. Panels C to E show the histogram for the coefficient of the bilateral export share regression obtained by sequentially dropping one exporting country (Panel C), importing country (Panel D), and industry (Panel E) at a time. Summary statistics of the distribution of coefficients depicted in each histogram are reported at the bottom of each figure. It is apparent that the estimated

¹⁰The annual series were filtered using a smoothing parameter of 100. The monthly series were filtered with a parameter of 14400.

¹¹I did not compute the HP filtered series for the bilateral specifications because the length of importer based unit values are shorter and less continuous than those for global unit values, which difficults the use of the HP filtering algorithm.

coefficients are tightly distributed around the baseline level. For instance, the mean coefficient in Panel A is -3.18 and has a standard deviation of 0.08. The situation is similar for all other panels. Therefore, dropping individual countries or industries has little impact on the estimated coefficient, which shows that the results are not crucially driven by specific dimensions of the data, but respond to a more robust pattern of variation.

4.4 The role of exchange rate regimes

An alternative way of testing for the relevance of natural hedge is to test whether it matters relatively more for the composition of exports during periods of flexible exchange rates than during various types of pegs. By construction the exchange rate can fluctuate more in the former than in the latter type of regime. To test this hypothesis, the regressions reported in Table 8 estimate the parameters of the baseline specification (Eq. [7]) across different exchange rate regimes, classified according to Reinhart and Rogoff (2004) in five categories comprising the spectrum between full pegs and fully flexible regimes. In these estimations, the triple interaction term $CORR_{i,h} \times SDXR_i \times SDP_h$ is replaced by the double interaction $CORR_{i,h} \times SDP_h$ because the goal is to test for differences in the importance of natural hedge across regimes, and the differences in exchange rate regimes are proxying for differences in the volatility of exchange rate. The specification for the bilateral export shares were not estimated because of the difficulty of defining a country's exchange rate regime against each of its trading partners.

The results for different regimes are presented in columns (1) to (4) by degree of flexibility, from the harder pegs to free floating.¹² They show that the main coefficient is clearly more negative in fully flexible regimes (Column (4)) than in the other ones. In fact, the regression reported in Column (5) shows that the natural hedge coefficient is significantly more negative than in other regimes. The negative coefficients during hard pegs is a bit surprising, but if the peg currency is not the US dollar there may still be important fluctuations in the dollar exchange rate (remember that prices are denominated in US dollars). The export share of a sector at the 10th percentile of correlation is 41 percent larger than that of a sector at the 90th percentile level in a floating regime than during hard and soft pegs. This unambiguously shows that natural hedge is significantly more important for export patterns in flexible exchange rate regimes than during pegs.

4.5 Natural hedge and country characteristics

The natural hedge against exchange rate fluctuations provided by some goods should be relatively more important in open countries where trade represents a larger fraction of GDP and is determined by market forces. One would also expect it to be less important when there are formal hedging instruments available to protect exporting firms against exchange rate risk or when financially sound

¹²I use the Reinhart and Rogoff (2004) coarse annual classification and exclude from the sample those regimes classified as "free falling" and those with dual pegs with missing data (categories 5 and 6).

exporting firms can easily borrow to overcome temporary fluctuations in real costs associated with exchange rate movements. The most appropriate financial instruments to hedge exchange rate risk are financial derivatives, such as futures and forwards of exchange rates that allow firms to fix the exchange rate at a future time, or exchange rate swaps that allow firms to trade exchange rate risks. However, these derivatives are relatively sophisticated and are not widely available, especially exchange rate futures that require some form of standardization and are traded in open exchanges. In most cases where there is a market for exchange rate risk this takes place over the counter. As mentioned in section 3, data on the depth of foreign exchange rate derivative markets comes from the Bank of International Settlements. The survey conducted by the BIS covers a set of 52 countries where these markets have some meaningful degree of activity. In the rest of the world, forex derivatives are largely nonexistent. However, even if there are no derivative markets that allow a firm to hedge exchange rate risk ex-ante, a well functioning financial market may provide liquidity to exporters facing temporary difficulties arising from exchange rate fluctuations. Thus, even in absence of direct hedging options the role of natural hedging may be stronger in financially underdeveloped countries.

To test the hypotheses that the degree of trade openness, and the development of forex derivatives and financial markets reduce the importance of natural hedge, I estimate the parameters of equation (7) separately for different groups of countries formed according to the median level of each these characteristics, allowing therefore the natural hedge parameter β to vary with these characteristics. The results of the estimation are reported in the two panels of Table 9. The first two columns separately estimate the coefficient among closed and open countries (i.e. those with total trade to GDP below and above the sample median, respectively). The results in both panels show a larger coefficient for natural hedge among open countries (Column (2)) than among closed ones (Column (1)), but the difference between these two groups is not significantly different from zero (see the *Test of Equality of Interaction* row at the bottom of the table that reports the p-value for the test that the coefficients in the two groups are identical).

The next two columns compare those countries where there is no forex derivatives market data and those where there is data, regardless of the size of the market (Columns (3) and (4), respectively). Surprisingly, the results clearly show that the coefficient is more negative and significant among countries where there is forex market data (Column (4)); in fact, in Panel A the coefficient is one order of magnitude larger among these countries than among countries with no data on forex markets. In Panel B that looks at bilateral trade patterns the difference between the two groups is smaller and statistically insignificant, although still the coefficient is larger among countries with forex data.

The regressions in columns (5) and (6) estimate the parameters of equations (7) and (8) among those countries with data on forex derivatives. Even within this group, the coefficient on natural hedge is more negative in countries with a high foreign exchange derivatives turnover, although the

difference with the coefficient obtained in countries with low turnover is not significant in either of the two panels.

Even if foreign exchange derivative markets are not well developed, natural hedge may be relatively unimportant if exporting firms can easily borrow to overcome temporary fluctuations in exchange rates (Caballero and Lorenzoni (2007)). To test for this possibility, the regressions in columns (7) and (8) estimate the baseline specifications among countries with financial development above and below the sample median (financial development is captured by the average ratio of private credit to GDP over the sample period, from Beck et al. (2000), revision 2006). Similarly to the results on the role of the development of derivative markets, the results surprisingly show that the coefficient is more negative among countries with high financial development, indicating that natural hedge is more important among these countries. This evidence suggests that the availability of formal hedging instruments or credit does not reduce the importance of the natural hedge offered by the comovement between international prices and nominal exchange rates at the sector level.

To check if these results come from persistent differences in trade patterns across countries, the specification in growth rates (Eq. [9]) was also estimated for each of the groups of countries described above. The results, reported in Table 10, are more favorable to the hypothesis that the availability of formal hedging attenuates the relevance of natural hedge. The results for global trade shares (Panel A) show that, while the coefficient for natural hedge is still larger among financially developed countries, it is now larger among countries with no derivatives data, and, among those countries with derivatives data, it is larger among countries with relatively lower development of derivatives markets. However, as shown at the bottom of the panel, none of these differences is statistically significant. The results for bilateral trade shares (Panel B) offer stronger support for the hypothesis. In these regressions, the coefficient for natural hedge is more negative among countries with relatively lower development of derivative markets and among financially underdeveloped countries (Columns (5) and (7), respectively). The former difference is also significant at the 5 percent level.

Overall, the results provide only mixed support for the view that the availability of formal hedging instruments reduces the trade impact of the natural hedge of a good against exchange rate volatility. Industries with stronger natural hedge do not capture a relatively larger share of exports in countries with low availability of hedge instruments. However, these industries' shares of a country's exports have increased during the sample period. These results can be reconciled if industries with stronger natural hedge had relatively larger initial shares in countries that developed formal hedging instruments. This could happen if the development of these instruments was an ex-post reaction to the role of exchange rate volatility. Since for data availability reasons the measures on the development of forex derivative markets is only available on the latest years of the sample, it could be that the results are picking on the endogenous response of forex at the aggregate level. This would also be consistent with the growth of the sectors with natural hedge slowing down as a result of this subsequent development. Of course, an alternative interpretation is that natural and

financial hedges are complements rather than substitutes. If that is the case, sectors with natural hedge would be the ones better able to use financial instruments and would be stronger in countries where these instruments are available. Disentangling these competing explanations is an interesting topic for future research.

5 Conclusion

This paper has shown evidence of an indirect causal effect of exchange rate volatility on trade by looking at the differential effect of this volatility on the export share of sectors producing commodities whose price correlation with the home country's exchange rate offers different degrees of natural hedge against exchange rate fluctuations. The results indicate that sectors that offer natural hedge (i.e. those whose international price comoves negatively with the country's nominal exchange rate) are indeed larger relative to others, even after controlling for standard determinants of trade composition, in countries with more volatile exchange rates. Thus, exchange rate volatility tilts the structure of trade towards sectors that produce goods that offer a natural hedge against this volatility. This differential effect comes mainly from countries with a floating exchange rate regime. Contrary to expectations, there is only weak evidence that the relation between natural hedge, exchange rate volatility, and export composition is stronger in countries where firms have no access to financial instruments to hedge currency risk, such as exchange rate derivatives.

Overall, the results provide evidence that exchange rate volatility has real consequences for trade and that the structure of trade responds not only to standard factors, such as endowments, but also to other more institutionally driven constraints. If what you export matters, as suggested by Hausmann et al. (2007), addressing these sources of inefficiencies would be a better way of reaching a trade pattern that is not driven by risk hedging than engaging in some sort of industrial policy.

The analysis of this paper can be extended along several dimensions. First, using more disaggregated data may permit obtaining better proxies of international price fluctuations and, therefore, better pinpoint the relevance of the natural hedge mechanism. This can be done by using other new sources of data, such as the Gaulier et al. (2007), BACI database, which has a shorter time span but covers trade at 6-digits of the Harmonized System. Second, the hedge provided by an industry depends not only on the commodity it produces, but also on how the price of their imported inputs comoves with the nominal exchange rate. This paper has taken the stance that that source of hedging operates largely independently of the one on the product side, but of course this does not need to be the case. Addressing this issue faces some serious problems of measuring that would require further assumptions, but it is an interesting area of future research.

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Table 1. Highest 20 Country-Commodity Pairs of Positive and Negative Correlation

Country	SITC code	Commodity	Correlation
Mexico	372	CRUSTACEANS AND MOLLUSCS,PREPARED OR PRESERVED	0.8448
Liberia	1124	SPIRITS;LIQUEURS, OTHER SPIRITUOUS BEVERAGES,N.E.S	0.8492
Slovenia	573	BANANAS,FRESH OR DRIED	0.8517
Indonesia	14	POULTRY, LIVE (I.E., FOWLS, DUCKS, GEESE, ETC.)	0.8517
Ethiopia	6551	KNITTED/CROCH.FAB.NOT ELAST.NOR RUBBERIZ.OF SYNT.F	0.8533
Yemen	6544	FABRICS,WOVEN,OF FLAX OR OF RAMIE	0.8537
Saudi arabia	6118	LEATHER,SPECIALLY DRESSED OR FINISED	0.8557
Ethiopia	6574	ELASTIC FABRICS AND TRIMMINGS	0.8568
Zambia	6344	WOOD-BASED PANELS,N.E.S.	0.8580
Haiti	7432	PARTS OF THE PUMPS & COMPRESSORS OF 743.1-	0.8595
Mozambique	7518	OFFICE MACHINES, N.E.S.	0.8631
El salvador	5913	WEED KILLERS (HERBICIDES)PACKED FOR SALE ETC.	0.8645
Slovenia	6575	TWINE,CORDAGE,ROPES & CABLES.& MANUFACTUR.THEREOF	0.8746
Mexico	5331	OTHER COLOURING MATTER	0.8759
Guatemala	5911	INSECTICIDES PACKED FOR SALE ETC.	0.8789
Peru	2877	MANGANESE ORES AND CONCENTRATES	0.8796
Israel	6118	LEATHER,SPECIALLY DRESSED OR FINISED	0.8843
Bolivia	5334	VARNISHES AND LACOUERS:DISTEMPERS,WATER PIGMENTS	0.8918
Israel	5334	VARNISHES AND LACOUERS:DISTEMPERS,WATER PIGMENTS	0.8955
Liberia	14	POULTRY, LIVE (I.E., FOWLS, DUCKS, GEESE, ETC.)	0.8994

Country	SITC code	Commodity	Correlation
Seychelles	5323	SYNTH.ORG.TANNING SUBSTANCES,& INORG.TANNING SUBST	-0.9000
Switzerland	2927	CUT FLOWERS AND FOLIAGE	-0.8995
Kenya	2686	WASTE OF SHEEPS/LAMBS WOOL OR OF OTHER ANIM.HAIR	-0.8990
Cyprus	7264	PRINTING PRESSES	-0.8990
Seychelles	5332	PRINTING INK	-0.8988
Spain	6912	STRUCTURES& PARTS OF STRUC.:ALUMINIUM:PLATES,RODS	-0.8985
Cyprus	6584	BED LINEN, TABLE LINEN, TOILET & KITCHEN LINEN ETC.	-0.8984
France	6794	CASTINGS OR IRON OR STEEL,IN THE ROUGH STATE	-0.8979
Belgium	620	SUGAR CONFECTIONERY AND OTHER SUGAR PREPARATIONS	-0.8978
Belgium	546	VEGETABLES,FROZEN OR IN TEMPORARY PRESERVATIVE	-0.8978
Denmark	620	SUGAR CONFECTIONERY AND OTHER SUGAR PREPARATIONS	-0.8972
Italy	7753	DISH WASHING MACHINES OF HOUSEHOLD TYPE	-0.8972
Myanmar	484	BAKERY PRODUCTS (E.G.,BREAD,BISCUITS,CAKES) ETC.	-0.8971
Spain	5323	SYNTH.ORG.TANNING SUBSTANCES,& INORG.TANNING SUBST	-0.8970
Norway	3224	PEAT,WHETHER/NOT COMPRES.INTO BALES NOT AGGLOMERA	-0.8969
Switzerland	2926	BULBS,TUBERS & RHIZOMES OF FLOWERING OR OF FOLIAGE	-0.8966
Norway	583	JAMS,FRUIT JELLIES, MARMALADES,FRUIT PUREE,COOKED	-0.8963
Malta	6973	DOM ESTIC-TYPE, NON-ELECTRIC HEATING, COOKING APPAR.	-0.8960
Seychelles	8821	CHEMICAL PRODUCTS & FLASHLIGHT MATERIALS	-0.8960
Norway	6635	SLAG WOOL. ROCK WOOL AND SIMILAR MINERAL WOOLS	-0.8959

Table 2. Relation Between Measures of Correlations and Variances at Different Frequencies

	Correlation exchange rate- sectoral price (BLS) within years (1)	Variance relative sectoral price (BLS and CPI) within years (2)	Std. dev. Sectoral price (BLS) within years (3)
Correlation exchange rate-sectoral price (BLS)	0.007** (0.003)		
Variance relative sectoral price across		0.017*** (0.000)	
Std. dev. Sectoral price across years			0.149*** (0.001)
Cons	-0.026*** (0.001)	-0.001*** (0.000)	0.004*** (0.000)
N	17599	19268	19642
R-sq	0.056	0.638	0.541

The table shows the estimated coefficients from regressions between various statistics computed using within-year, monthly data on nominal exchange rate, CPI, and sectoral prices from BLS, and the same statistics computed using across-years, annual frequency data, after controlling for country fixed effects. In column (1) the dependent variable is the within-year correlation between a country's monthly (growth of) nominal exchange rate and a sector's price (from BLS). In column (2), the dependent variable is the within-year monthly variance of (the growth of) a sector's relative price (the difference in the growth of the BLS index and a country's CPI). In column (3), the dependent variable is the within-year monthly standard deviation of a sector's price. In each column, the explanatory variable is the corresponding statistic computed using annual data. . *, **, and *** denote significance at 10, 5, and 1

Table 3. Natural Hedge and the Composition of Trade. Baseline Results

	A. Total Trade Shares			B. Bilateral Trade Shares		
	(1)	(2)	(3)	(4)	(5)	(6)
Variance real commodity price	0.154 (0.370)	-0.355 (0.493)	-0.278 (0.440)	-0.290*** (0.037)	-0.267*** (0.040)	-0.270*** (0.040)
CorrelationX SD Exch. Rate X SD commodity price	-3.179*** (0.909)	-2.393** (0.870)	-1.367* (0.774)	-0.839*** (0.128)	-0.800*** (0.140)	-0.840*** (0.139)
Skill Intensity X Human Cap./ Worker		4.419*** (0.567)			0.582*** (0.146)	
Capital Intensity X Capital / Worker		1.164 (0.774)			0.594** (0.248)	
Resource Intensity X Land Area / Worker		0.233*** (0.037)			0.113*** (0.013)	
Factor Intensity X Output / Worker			1.219*** (0.074)			0.244*** (0.019)
Observations	57484	49798	49948	157433	144396	144396
R-squared	0.361	0.390	0.411	0.198	0.205	0.210
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	--	--	--
Country-pair FE				Yes	Yes	Yes

In Panel A the dependent variable is the log of a commodity's share of total global country exports, so the regressions explain a country's total trade patterns. In Panel B, the dependent variable is the log of a commodity's share of total country exports to each trading partner. These regressions therefore explain bilateral trade patterns. Variance real commodity price is the variance of the growth rate of the ratio of a commodity's price to a country's aggregate price level. In Panel A the commodity price is the average world price and in Panel B is the price in each trading partner. Correlation is the correlation between a country's nominal exchange rate growth and the growth the world price of each commodity (across years from annual data). SD Exch Rate is the standard deviation of a country's nominal exchange rate growth (within a year from monthly data) and SD commodity price is the standard deviation of the growth rate of a commodity's international prices. In panel B, the growth of a commodity price is computed within each trading partner. The symbol X denotes the interaction between variables. Skilled, Capital, Resource, and Factor Intensity are measures of a commodity's intensity of use of skilled labor, capital, resources, and all factors in general, and are computed as the weighted average of factor abundance of countries that export a commodity. The weight is the share of a country's exports represented by a commodity. These commodity specific measures are interacted with each country's abundance of different factors (human capital, capital, resources, and resources). Heterskedasticity robust standard errors reported in parenthesis. *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

Table 4. Natural Hedge and the Composition of Trade. Specification in Growth Rates

	A. Total Trade Shares			B. Bilateral Trade Shares		
	(1)	(2)	(3)	(4)	(5)	(6)
(log) Initial Export Share	-0.031*** (0.002)	-0.030*** (0.001)	-0.030*** (0.001)	-0.043*** (0.001)	-0.042*** (0.001)	-0.042*** (0.001)
Variance real commodity price	0.011 (0.030)	-0.020 (0.039)	-0.020 (0.040)	-0.023*** (0.004)	-0.021*** (0.004)	-0.021*** (0.004)
CorrelationX SD Exch. Rate X SD commodity price	-0.222*** (0.057)	-0.150** (0.061)	-0.133** (0.060)	-0.035** (0.018)	-0.031* (0.019)	-0.031* (0.019)
Skill Intensity X Human Cap./ Worker		0.072 (0.049)			-0.025** (0.010)	
Capital Intensity X Capital / Worker		0.076 (0.077)			0.014 (0.016)	
Resource Intensity X Land Area / Worker		0.008*** (0.002)			0.005*** (0.001)	
Factor Intensity X Output / Worker			0.023 (0.005)			-0.002 (0.001)
Long run coefficient	-7.1386***	-5.0342**	-4.3957**	-0.827**	-0.748*	-0.756*
Observations	43249	38784	38784	157357	144322	144322
R-squared	0.119	0.125	0.125	0.177	0.180	0.179
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	--	--	--
Country-pair FE	--	--	--	Yes	Yes	Yes

In Panel A the dependent variable is the growth of a commodity's share of total global country exports. In Panel B, the dependent variable is the growth of a commodity's share of total country exports to each trading partner. Initial Export Share is the share of a commodity in a country's total (bilateral) trade at the beginning of the sample period (or the first value if the initial value is zero) in Panel A (Panel B). Variance real commodity price is the variance of the growth rate of the ratio of a commodity's price to a country's aggregate price level. In Panel A the commodity price is the average world price and in Panel B is the price in each trading partner. Correlation is the correlation between a country's nominal exchange rate growth and the growth the world price of each commodity (across years from annual data). SD Exch Rate is the standard deviation of a country's nominal exchange rate growth (within a year from monthly data) and SD commodity price is the standard deviation of the growth rate of a commodity's international prices. In panel B, the growth of a commodity price is computed within each trading partner. The symbol X denotes the interaction between variables. Skilled, Capital, Resource, and Factor Intensity are measures of a commodity's intensity of use of skilled labor, capital, resources, and all factors in general, and are computed as the weighted average of factor abundance of countries that export a commodity. The weights are the shares of a country's exports represented by a commodity. These commodity specific measures are interacted with each country's abundance of different factors (human capital, capital, resources, and resources). Heteroskedasticity robust standard errors reported in parenthesis. *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

Table 5. Controlling for Potential Feedback from Trade Shares to Correlations

	Diff.	Homo		Share<.0	Share<.0	Global	
	goods	goods	Share< .1	5	1	Shares	IV
	(1)	(2)	(3)	(4)	(5)	(4)	(5)
A: Global Trade Shares							
Variance real commodity price	0.205 (0.330)	-0.879 (1.542)	0.198 (0.366)	0.175 (0.357)	0.149 (0.323)	0.1653 (0.3716)	-1.659* (1.006)
CorrelationX SD Exch. Rate	-3.277*** (0.828)	2.735 (1.895)	-3.121*** (0.887)	-3.082*** (0.852)	-2.834*** (0.806)	-3.1804*** (0.9212)	-28.80** (10.98)
X SD commodity price							
Observations	47100	5653	57332	57158	55833	57484	55267
R-squared	0.382	0.363	0.363	0.366	0.367	0.624	--
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	(1)	(2)	(3)	(4)	(5)	(4)	(5)
B: Bilateral Trade Shares							
Variance real commodity price	-0.309*** (0.038)	-1.078*** (0.245)	-0.270*** (0.037)	-0.253*** (0.038)	-0.167*** (0.038)	--	--
CorrelationX SD Exch. Rate	-0.875*** (0.134)	-0.728 (0.946)	-0.704*** (0.126)	-0.649*** (0.125)	-0.469*** (0.123)	--	--
X SD commodity price							
Observations	140222	8283	152527	148694	127144	--	--
R-squared	0.179	0.293	0.183	0.177	0.156		
Industry FE	Yes	Yes	Yes	Yes	Yes	--	--
Country-pair FE	Yes	Yes	Yes	Yes	Yes	--	--

In Panel A the dependent variable is the log of a commodity's share of total global country exports, except in column (6) where it is the log share of a country's commodity's exports on global exports of that commodity. In Panel B, it is the log of a commodity's share of total country exports to each trading partner. Variance real commodity price is the variance of the growth rate of the ratio of a commodity's price to a country's aggregate price level. In Panel A the commodity price is the average world price and in Panel B is the price in each trading partner. Correlation is the correlation between a country's nominal exchange rate growth and the growth the world price of each commodity (across years from annual data). SD Exch Rate is the standard deviation of a country's nominal exchange rate growth (within a year from monthly data) and SD commodity price is the standard deviation of the growth rate of a commodity's international prices. In panel B, the growth of a commodity price is computed within each trading partner. The symbol X denotes the interaction between variables. Columns (1) and (2) report regressions estimated in the sample of differentiated and homogeneous goods respectively (according to Rauch (1995) classification). The regressions in columns (3) to (5) sequentially exclude from the sample all commodities where a country has a total (bilateral in Panel B) export share larger than 10, 5, and 1 percent respectively. The regression in column (7) was estimated by two-stages least squares using as instruments for the correlation in each country-industry the correlation computed for each industry in the UK, France and Japan. Heterskedasticity robust standard errors reported in parenthesis, clustered at the country (country-pair) level in Panel A (B). *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

Table 6. Natural Hedge and the Composition of Trade. Moments Based on HP Filtered

<u>Series</u>	Total Trade Shares		
	(1)	(2)	(3)
Variance real commodity price	-0.003 (0.085)	0.017 (0.080)	0.027 (0.083)
CorrelationX SD Exch. Rate X SD commodity price	-1.825*** (0.494)	-1.455** (0.466)	-1.016** (0.403)
Skill Intensity X Human Cap./ Worker		4.421*** (0.568)	
Capital Intensity X Capital / Worker		1.175 (0.773)	
Resource Intensity X Land Area / Worker		0.233*** (0.037)	
Factor Intensity X Output / Worker			1.220*** (0.074)
Observations	57484	49798	49948
R-squared	0.360	0.390	0.411
Industry FE	Yes	Yes	Yes
Country FE	Yes	Yes	Yes

The dependent variable is the log of a commodity's share of total global country exports. Variance real commodity price is the variance of the growth rate of the ratio of a commodity's price to a country's aggregate price level. The commodity price is the average world price. Correlation is the correlation between a country's nominal exchange rate growth and the growth the world price of each commodity (across years from annual data). SD Exch Rate is the standard deviation of a country's nominal exchange rate growth (within a year from monthly data) and SD commodity price is the standard deviation of the growth rate of a commodity's international prices. The symbol X denotes the interaction between variables. Skilled, Capital, Resource, and Factor Intensity are measures of a commodity's intensity of use of skilled labor, capital, resources, and all factors in general, and are computed as the weighted average of factor abundance of countries that export a commodity. The weights are the share of a country's exports represented by a commodity. These commodity specific measures are interacted with each country's abundance of different factors (human capital, capital, resources, and resources). Heterskedasticity robust standard errors reported in parenthesis. *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

Table 7. Robustness to Dropping Extreme Observations

	Restrict Correlation (Corr <0.8) (1)	Restrict obs. to compute corr. (obs>12) (2)	Restrict number of sectors (3)
A: Global Trade Shares			
Variance real commodity price	0.170 (0.378)	0.149 (0.448)	0.158 (0.369)
CorrelationX SD Exch. Rate X SD commodity price	-3.086** (0.921)	-3.333** (1.005)	-3.169*** (0.908)
Observations	56714	53645	57451
R-squared	0.360	0.363	0.360
Industry FE	Yes	Yes	Yes
Country FE	Yes	Yes	Yes
	(1)	(2)	(3)
B: Bilateral Trade Shares			
Variance real commodity price	-0.288*** (0.037)	-0.478*** (0.051)	-0.219*** (0.040)
CorrelationX SD Exch. Rate X SD commodity price	-0.926*** (0.131)	-1.482*** (0.218)	-0.819*** (0.148)
Observations	152758	78380	136546
R-squared	0.198	0.246	0.194
Industry FE	Yes	Yes	Yes
Country-pair FE	Yes	Yes	Yes

In Panel A the dependent variable is the log of a commodity's share of total global country exports. In Panel B, it is the log of a commodity's share of total country exports to each trading partner. Variance real commodity price is the variance of the growth rate of the ratio of a commodity's price to a country's aggregate price level. In Panel A the commodity price is the average world price and in Panel B is the price in each trading partner. Correlation is the correlation between a country's nominal exchange rate growth and the growth the world price of each commodity (across years from annual data). SD Exch Rate is the standard deviation of a country's nominal exchange rate growth (within a year from monthly data) and SD commodity price is the standard deviation of the growth rate of a commodity's international prices. In panel B, the growth of a commodity price is computed within each trading partner. The symbol X denotes the interaction between variables. The regression in column (1) include only sectors where the correlation between nominal exchange rate and international price fluctuations is smaller than 0.8 in absolute value. Column (2) includes only those country-industries where the correlation was computed with more than 12 annual observations (the baseline is 8 observations). Finally, column (3) includes only those commodities that are exported by more than 20 countries and countries that export more than 20 commodities. Heterskedasticity robust standard errors reported in parenthesis, clustered at the country (country-pair) level in Panel A (B). *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

Table 8. Differences Across Exchange Rate Regimes

	Regime 1	Regime 2	Regime 3	Regime 4	Free floating
	(1)	(2)	(3)	(4)	(5)
Variance real commodity price	0.048 (0.461)	-0.019 (1.010)	-1.930 (1.829)	0.115 (0.777)	-0.383 (0.279)
CorrelationX SD commodity price	-2.271** (0.779)	-1.812** (0.657)	-0.770 (0.658)	-3.608** (1.115)	-1.596*** (0.125)
Free Float X Variance real commodity price					0.498 (0.669)
Free Float X Correl. X SD commodity price					-2.012*** (0.581)
Observations	19952	26745	20425	3606	70728
R-squared	0.396	0.340	0.380	0.513	0.359
Industry FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes

The dependent variable is the log of a commodity's share of total global country exports. Variance real commodity price is the variance of the growth rate of the ratio of a commodity's price to a country's aggregate price level. The commodity price is the average world. Correlation is the correlation between a country's nominal exchange rate growth and the growth the world price of each commodity (across years from annual data). SD Exch Rate is the standard deviation of a country's nominal exchange rate growth (within a year from monthly data) and SD commodity price is the standard deviation of the growth rate of a commodity's international prices. The symbol X denotes the interaction between variables. Columns (1) to (4) show results restricted to periods where the exporting country was in each of the four main exchange rate regimes according to the classification of Reinhart and Rogoff (2004). The degree of flexibility of the regime increases from 1 (hard pegs) to (4) flexible regimes. Column (5) nest the 4 specification including a dummy for countries with a flexible exchange rate regime and interacting it with the variables of the baseline specification. Heterskedasticity robust standard errors reported in parenthesis, clustered at the country (country-pair) level in Panel A (B). *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

Table 9. Differences Across Groups of Countries

	Closed	Open	No Forex Data	Forex Data	Low Forex	High Forex	Low Fin. Develop.	High Fin. Develop
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A: Global Trade Shares								
Variance real commodity price	-0.008 (0.572)	0.096 (0.654)	0.241 (0.477)	-0.032 (0.378)	0.634 (0.743)	-0.287 (0.445)	0.554 (0.559)	-0.450 (0.689)
CorrelationX SD Exch. Rate X SD commodity price	-3.147** (1.085)	-4.015** (1.582)	-5.658*** (1.232)	-0.445 (0.787)	-4.090** (1.389)	-5.926** (2.829)	0.618 (0.834)	-6.238*** (1.433)
Observations	28595	27135	25767	31717	15961	15756	19174	36209
R-squared	0.379	0.380	0.374	0.477	0.485	0.536	0.350	0.433
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Test of Equality of interaction coefficients	0.651		0.000		0.560		0.000	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
B: Bilateral Trade Shares								
Variance real commodity price	-0.342*** (0.055)	-0.214*** (0.045)	-0.548*** (0.156)	-0.284*** (0.038)	-0.308*** (0.053)	-0.308*** (0.051)	-0.185** (0.064)	-0.369*** (0.047)
CorrelationX SD Exch. Rate X SD commodity price	-0.681*** (0.160)	-1.028*** (0.206)	-0.212 (0.525)	-0.844*** (0.129)	-0.856*** (0.159)	-0.739*** (0.207)	-0.500** (0.205)	-0.839*** (0.161)
Observations	84539	72405	9386	148047	98680	58753	52564	96343
R-squared	0.224	0.215	0.375	0.198	0.212	0.269	0.226	0.235
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	0.183		0.242		0.654		0.193	

In Panel A the dependent variable is the log of a commodity's share of total global country exports. In Panel B, it is the log of a commodity's share of total country exports to each trading partner. *Variance real commodity price* is the variance of the growth rate of the ratio of a commodity's price to a country's aggregate price level. In Panel A the commodity price is the average world price and in Panel B is the price in each trading partner. *Correlation* is the correlation between a country's nominal exchange rate growth and the growth the world price of each commodity (across years from annual data). *SD Exch Rate* is the standard deviation of a country's nominal exchange rate growth (within a year from monthly data) and *SD commodity price* is the standard deviation of the growth rate of a commodity's international prices. In panel B, the growth of a commodity price is computed within each trading partner. The symbol X denotes the interaction between variables. Columns (1) and (2) report regressions estimated among exporting countries with average total trade to GDP below and above the sample median (Closed and open respectively). Columns (3) and (4) compare the coefficients of the model between countries with a ratio of private credit to GDP below and above the sample median (financially underdeveloped and financially developed), respectively. Columns (5) and (6) do the same for countries with and without data on the development of foreign exchange derivative markets on the Bank for International Settlements triennial survey of central banks. Finally, columns (5) and (6) compare, among countries with forex derivative market data, those with forex turnover (as a fraction of GDP) below and above the sample median. Heterskedasticity robust standard errors reported in parenthesis, clustered at the country (country-pair) level in Panel A (B). *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

Table 10. Differences across Groups of Countries. Specification in Growth Rates

	Closed	Open	No Forex Data	Forex Data	Low Forex	High Forex	Low Fin. Develop.	High Fin. Develop
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A: Global Trade Shares								
(log) Initial Export Share	-0.031*** (0.002)	-0.032*** (0.003)	-0.040*** (0.002)	-0.032*** (0.002)	-0.034*** (0.002)	-0.030 (0.004)	-0.039*** (0.004)	-0.029*** (0.001)
Variance real commodity price	-0.013 (0.039)	0.021 (0.051)	-0.069 (0.055)	0.032 (0.034)	0.038 (0.047)	0.043 (0.052)	0.041 (0.055)	-0.042 (0.033)
CorrelationX SD Exch. Rate X SD commodity price	-0.239** (0.070)	-0.189* (0.102)	-0.245** (0.104)	-0.150** (0.065)	-0.163** (0.078)	-0.021 (0.137)	-0.157* (0.094)	-0.251** (0.098)
Observations	22272	19986	14106	29143	14494	14649	11814	30087
R-squared	0.139	0.134	0.125	0.198	0.221	0.223	0.156	0.140
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Test of Equality of interaction co	0.686		0.439		0.368		0.489	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
B: Bilateral Trade Shares								
(log) Initial Export Share	-0.044*** (0.001)	-0.042*** (0.001)	-0.048*** (0.002)	-0.042*** (0.001)	-0.045*** (0.001)	-0.039*** (0.001)	-0.046*** (0.001)	-0.041*** (0.001)
Variance real commodity price	-0.028*** (0.005)	-0.014** (0.006)	-0.046* (0.024)	-0.022*** (0.004)	-0.033*** (0.005)	-0.008 (0.005)	-0.033*** (0.007)	-0.016*** (0.004)
CorrelationX SD Exch. Rate X SD commodity price	-0.013 (0.021)	-0.070** (0.032)	-0.021 (0.085)	-0.034* (0.018)	-0.060** (0.022)	0.020 (0.031)	-0.060** (0.028)	-0.019 (0.023)
Observations	84488	72380	9377	147980	98624	58733	52540	96306
R-squared	0.192	0.180	0.251	0.179	0.200	0.167	0.193	0.178
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	0.136		0.881		0.035		0.258	

In Panel A the dependent variable is the log of a commodity's share of total global country exports. In Panel B, it is the log of a commodity's share of total country exports to each trading partner. *Variance real commodity price* is the variance of the growth rate of the ratio of a commodity's price to a country's aggregate price level. In Panel A the commodity price is the average world price and in Panel B is the price in each trading partner. *Correlation* is the correlation between a country's nominal exchange rate growth and the growth the world price of each commodity (across years from annual data). *SD Exch Rate* is the standard deviation of a country's nominal exchange rate growth (within a year from monthly data) and *SD commodity price* is the standard deviation of the growth rate of a commodity's international prices. In panel B, the growth of a commodity price is computed within each trading partner. The symbol X denotes the interaction between variables. Columns (1) and (2) report regressions estimated among exporting countries with average total trade to GDP below and above the sample median (Closed and open respectively). Columns (3) and (4) compare the coefficients of the model between countries with a ratio of private credit to GDP below and above the sample median (financially underdeveloped and financially developed), respectively. Columns (5) and (6) do the same for countries with and without data on the development of foreign exchange derivative markets on the Bank for International Settlements triennial survey of central banks. Finally, columns (5) and (6) compare, among countries with forex derivative market data, those with forex turnover (as a fraction of GDP) below and above the sample median. Heterskedasticity robust standard errors reported in parenthesis, clustered at the country (country-pair) level in Panel A (B). *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

**Figure 1. Within Commodity Correlation Between Growth in Price Indexes from
BLS and Global Unit Values**

A. Regression including all growth rates smaller than 1 in absolute value

B. Regression including all growth rates smaller than 0.2 in absolute value

The figure shows the partial scatter plots of a regression between the growth rate of global unit value and the growth rates of BLS import price indexes during the period 1993-2000. Each regression includes commodity level fixed effects. The regression in Panel A (B) restricts the sample to include only commodity-years where the growth rate of both price indicators was below 1 (0.2) in absolute value. Each figure also shows the fitted regression line. The estimated coefficient for the partial regression, its standard error, and the corresponding t-statistic are reported at the bottom of each scatter plot.

Figure 2. Average Correlations within Countries and Commodities

A. Average correlation within a country

B. Average correlation within a 3-digit SITC commodity

The two panels of the figure show the average correlation between a country's annual growth in its nominal exchange rate against the dollar and the annual growth of a commodity's international price within a country (Panel A) and within a 3-digit SITC industry.

Figure 3. Distribution of Correlation Values Across Countries and SITC

Number of Observatio	Average	Median	25 percentile	75 percentile	Fraction of 5%	Fraction of 10%	Fraction of 20%
57484	-0.1122	-0.0813	-0.3362	0.1066	0.1535	0.2176	0.3167

The figure shows the histogram of the correlation between a country's annual growth in its nominal exchange rate against the dollar and the annual growth of a commodity's international price. The two vertical lines at -0.9 and 0.9 show the truncation points used in the analysis (all correlations outside this range were not included). The table at the bottom shows several summary statistics for the distribution of these correlations: the total number of correlations included, as well as their average, median, an 25th and 75th percentiles. It also shows the fraction of the correlations that are statistically significant at the 5, 10, and 20 percent level.

Figure 4. Histogram of Coefficients for Natural Hedge Obtained after Dropping Countries, Country-Pairs, and

Industries

Global Shares

A. Dropping one exporting country at a time

Mean = -3.18, Std. Dev= 0.08

B. Dropping one commodity at a time

Mean = -3.18, Std. Dev= 0.02

Bilateral Shares

C. Dropping one exporting country at a time

Mean = -0.84, Std. Dev= 0.01

D. Dropping one importing country at a time

Mean = -0.84, Std. Dev= 0.01

E. Dropping one commodity at a time

Mean = -0.84, Std. Dev= 0.005

Each panel shows the empirical distribution of the coefficient of natural hedge for global export shares (Panels A and B) and bilateral export shares (Panels C to E) after dropping one exporting country at a time (Panels A and C), one importing country at a time (Panel D), and one commodity at a time (Panels B and E). The mean and standard deviation of the empirical distribution are reported at the bottom of each panel.

Appendix. Summary Statistics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Country	Average Export Share	Average Global Export Share	Number of Commodity	Average Std. Dev. of Nominal Exch. Rate	Average correlation	Minimum correlation	Maximum correlation
Albania	0.0022	0.0002	416	0.67	-0.11	-0.83	0.74
Algeria	0.0020	0.0011	461	0.30	0.01	-0.65	0.65
Argentina	0.0014	0.0081	697	0.84	0.17	-0.69	0.68
Australia	0.0012	0.0147	738	0.27	-0.14	-0.78	0.54
Austria	0.0013	0.0122	715	0.31	-0.39	-0.90	0.48
Bahamas, The	0.0031	0.0005	309	0.00	0.00	0.00	0.00
Bahrain	0.0025	0.0005	387	0.00	-0.16	-0.76	0.41
Bangladesh	0.0026	0.0042	373	0.07	-0.05	-0.63	0.59
Barbados	0.0041	0.0001	211	0.00	0.00	0.00	0.00
Belgium	0.0011	0.0339	729	0.31	-0.39	-0.90	0.56
Belize	0.0043	0.0001	233	0.00	0.00	0.00	0.00
Benin	0.0078	0.0012	124	0.43	-0.15	-0.61	0.55
Bolivia	0.0031	0.0010	285	0.89	0.04	-0.78	0.89
Brazil	0.0014	0.0167	704	0.66	0.16	-0.56	0.60
Burkina Faso	0.0061	0.0004	133	0.43	-0.17	-0.61	0.41
Burundi	0.0104	0.0003	77	0.29	-0.36	-0.80	0.32
Cambodia	0.0047	0.0002	195	0.72	0.02	-0.68	0.57
Cameroon	0.0035	0.0011	287	0.43	-0.17	-0.70	0.56
Canada	0.0013	0.0351	739	0.12	-0.11	-0.71	0.78
Central African Republic	0.0032	0.0002	127	0.43	-0.20	-0.69	0.41
Chad	0.0155	0.0006	64	0.43	-0.08	-0.70	0.56
Chile	0.0015	0.0050	659	0.20	0.06	-0.77	0.84
China	0.0013	0.0509	739	0.20	0.16	-0.73	0.70
Colombia	0.0015	0.0020	640	0.14	0.11	-0.62	0.72
Congo, Dem. Rep.	0.0040	0.0016	168	1.47	-0.02	-0.50	0.49
Congo, Rep.	0.0055	0.0008	156	0.43	-0.15	-0.70	0.56
Costa Rica	0.0021	0.0012	462	0.06	0.12	-0.65	0.69
Cote d'Ivoire	0.0024	0.0025	398	0.43	-0.18	-0.70	0.56
Croatia	0.0017	0.0009	569	0.48	-0.08	-0.88	0.84
Cyprus	0.0016	0.0004	560	0.25	-0.44	-0.90	0.48
Denmark	0.0012	0.0112	714	0.30	-0.39	-0.90	0.48
Djibouti	0.0074	0.0001	111	0.00	0.00	0.00	0.00
Dominican Republic	0.0023	0.0023	395	0.47	0.12	-0.59	0.81
Ecuador	0.0019	0.0020	508	0.58	-0.01	-0.79	0.79
Egypt, Arab Rep.	0.0016	0.0010	628	0.31	0.08	-0.64	0.73
El Salvador	0.0037	0.0006	268	0.18	0.22	-0.68	0.86
Equatorial Guinea	0.0183	0.0003	54	0.43	-0.08	-0.57	0.50
Ethiopia	0.0045	0.0008	216	0.23	-0.12	-0.78	0.38
Finland	0.0014	0.0084	707	0.30	-0.40	-0.89	0.52
France	0.0012	0.0597	729	0.30	-0.38	-0.90	0.60
Gabon	0.0047	0.0017	208	0.43	-0.17	-0.69	0.56
Gambia, The	0.0050	0.0002	104	0.36	0.08	-0.66	0.54
Germany	0.0012	0.0872	706	0.30	-0.39	-0.90	0.55
Ghana	0.0031	0.0012	267	0.42	-0.09	-0.71	0.63

Continues

Country	(1) Average Export Share	(2) Average Global Export Share	(3) Number of Commodity	(4) Average Std. Dev. of Nominal Exch. Rate	(5) Average correlation	(6) Minimum correlation	(7) Maximum correlation
Greece	0.0013	0.0040	713	0.28	-0.31	-0.83	0.53
Guatemala	0.0028	0.0013	356	0.39	0.23	-0.61	0.88
Guyana	0.0039	0.0005	139	0.63	0.13	-0.61	0.61
Haiti	0.0051	0.0005	191	0.32	-0.19	-0.74	0.32
Honduras	0.0033	0.0012	299	0.17	0.07	-0.44	0.72
Hong Kong, China	0.0012	0.0098	720	0.01	-0.19	-0.74	0.54
Hungary	0.0013	0.0041	706	0.24	-0.29	-0.82	0.67
Iceland	0.0021	0.0013	428	0.23	-0.13	-0.67	0.57
India	0.0011	0.0110	724	0.18	-0.07	-0.77	0.53
Indonesia	0.0014	0.0103	709	0.42	0.03	-0.86	0.85
Iran, Islamic Rep.	0.0016	0.0017	603	0.56	-0.14	-0.72	0.52
Ireland	0.0013	0.0078	710	0.30	-0.40	-0.89	0.45
Israel	0.0010	0.0034	675	0.26	0.05	-0.77	0.90
Italy	0.0013	0.0513	744	0.30	-0.34	-0.90	0.45
Jamaica	0.0015	0.0004	389	0.27	0.02	-0.53	0.68
Japan	0.0013	0.0653	739	0.34	-0.14	-0.75	0.65
Jordan	0.0021	0.0007	467	0.11	0.02	-0.61	0.68
Kenya	0.0023	0.0015	424	0.32	-0.20	-0.90	0.40
Korea, Rep.	0.0013	0.0187	724	0.19	-0.02	-0.82	0.81
Kuwait	0.0020	0.0010	501	0.09	-0.21	-0.71	0.54
Lao PDR	0.0056	0.0001	177	0.78	0.08	-0.56	0.57
Latvia	0.0021	0.0006	463	0.27	-0.26	-0.81	0.51
Lebanon	0.0015	0.0004	481	0.68	0.30	-0.35	0.76
Liberia	0.0037	0.0006	185	0.82	-0.03	-0.72	0.85
Libya	0.0035	0.0010	283	0.21	-0.08	-0.61	0.50
Lithuania	0.0019	0.0007	519	0.15	-0.08	-0.89	0.81
Macao, China	0.0022	0.0009	446	0.01	-0.15	-0.75	0.67
Madagascar	0.0045	0.0015	212	0.49	0.16	-0.41	0.63
Malawi	0.0073	0.0010	136	0.44	-0.04	-0.46	0.46
Malaysia	0.0014	0.0117	718	0.18	-0.05	-0.78	0.81
Mali	0.0045	0.0003	198	0.43	-0.16	-0.70	0.50
Malta	0.0020	0.0003	479	0.22	-0.42	-0.90	0.35
Mauritania	0.0064	0.0004	153	0.28	-0.25	-0.74	0.33
Mauritius	0.0029	0.0006	321	0.21	-0.26	-0.79	0.41
Mexico	0.0013	0.0108	724	0.27	0.35	-0.41	0.88
Mongolia	0.0039	0.0006	237	1.20	-0.03	-0.69	0.70
Morocco	0.0016	0.0031	596	0.22	-0.36	-0.89	0.47
Mozambique	0.0031	0.0004	319	0.61	0.18	-0.50	0.64
Myanmar	0.0026	0.0009	357	0.17	-0.33	-0.90	0.58
Nepal	0.0033	0.0006	295	0.18	0.04	-0.72	0.52
Netherlands	0.0012	0.0443	728	0.31	-0.38	-0.89	0.55
New Zealand	0.0014	0.0055	682	0.29	-0.26	-0.81	0.59
Niger	0.0009	0.0001	242	0.43	-0.20	-0.71	0.50
Nigeria	0.0025	0.0015	397	0.84	-0.02	-0.71	0.80
Norway	0.0014	0.0071	687	0.27	-0.41	-0.90	0.46
Pakistan	0.0017	0.0035	569	0.14	-0.29	-0.86	0.47
Panama	0.0016	0.0005	565	0.00	0.00	0.00	0.00
Papua New Guinea	0.0038	0.0037	223	0.29	-0.10	-0.70	0.45

Continues

Country	(1) Average Export Share	(2) Average Global Export Share	(3) Number of Commodity	(4) Average Std. Dev. of Nominal Exch. Rate	(5) Average correlation	(6) Minimum correlation	(7) Maximum correlation
Paraguay	0.0025	0.0010	376	0.48	0.07	-0.63	0.70
Peru	0.0016	0.0032	570	1.06	0.17	-0.65	0.68
Philippines	0.0014	0.0055	679	0.23	-0.08	-0.76	0.81
Poland	0.0013	0.0063	721	0.60	0.17	-0.65	0.78
Portugal	0.0014	0.0061	719	0.28	-0.36	-0.86	0.45
Qatar	0.0033	0.0005	302	0.00	0.00	0.00	0.00
Romania	0.0015	0.0025	639	0.84	-0.17	-0.72	0.35
Rwanda	0.0105	0.0005	86	0.33	-0.03	-0.70	0.53
Samoa	0.0125	0.0003	78	0.20	-0.26	-0.76	0.38
Saudi Arabia	0.0015	0.0038	642	0.01	0.19	-0.68	0.86
Senegal	0.0040	0.0017	231	0.43	-0.16	-0.70	0.55
Seychelles	0.0063	0.0001	150	0.17	-0.34	-0.89	0.45
Sierra Leone	0.0022	0.0002	204	0.92	0.28	-0.51	0.69
Singapore	0.0013	0.0088	736	0.13	-0.23	-0.71	0.69
Slovenia	0.0016	0.0022	618	0.36	0.02	-0.85	0.87
South Africa	0.0010	0.0071	730	0.34	-0.19	-0.83	0.52
Spain	0.0011	0.0183	738	0.30	-0.39	-0.90	0.34
Sri Lanka	0.0019	0.0025	490	0.11	-0.19	-0.81	0.54
St. Kitts and Nevis	0.0020	0.0002	461	0.00	0.00	0.00	0.00
Sudan	0.0037	0.0022	262	1.06	0.02	-0.52	0.62
Suriname	0.0017	0.0003	177	1.22	0.01	-0.52	0.57
Sweden	0.0013	0.0164	724	0.27	-0.35	-0.86	0.42
Switzerland	0.0010	0.0178	731	0.35	-0.37	-0.90	0.52
Syrian Arab Republic	0.0022	0.0008	459	0.21	0.11	-0.75	0.72
Tanzania	0.0038	0.0012	252	0.39	0.29	-0.34	0.81
Thailand	0.0013	0.0098	717	0.20	-0.10	-0.79	0.58
Togo	0.0064	0.0008	149	0.43	-0.14	-0.70	0.56
Trinidad and Tobago	0.0031	0.0006	314	0.18	0.09	-0.63	0.59
Tunisia	0.0016	0.0017	597	0.26	-0.37	-0.83	0.44
Turkey	0.0014	0.0078	716	0.29	-0.13	-0.67	0.53
Uganda	0.0073	0.0007	136	0.80	0.23	-0.40	0.65
United Kingdom	0.0012	0.0460	749	0.29	-0.33	-0.84	0.46
Uruguay	0.0015	0.0013	583	0.19	0.32	-0.46	0.81
Venezuela, RB	0.0016	0.0021	623	0.67	0.02	-0.62	0.85
Yemen, Rep.	0.0059	0.0004	168	0.75	0.20	-0.62	0.74
Zambia	0.0051	0.0009	187	1.08	0.02	-0.69	0.51
Zimbabwe	0.0021	0.0012	447	0.41	-0.22	-0.77	0.60

Average export share is the average across commodities (3-digit SITC classification) of the share of a country's total exports represented by each of the commodities that a country exported between 1985 and 2000. Average global export share is the average across commodities of the share of global commodity exports represented by each of the commodities exported by a country between 1985 and 2000. Number of commodities is the number of 3 digit SITC sector exported by a country during the same period. Average standard deviation of nominal exchange rate is the average of the within year standard deviation of the monthly growth of a country's nominal exchange rate against the US dollar. Average correlation is the average correlation between a country's nominal exchange rate growth and the growth the world price of each commodity (across years from annual data) across the commodities exported by a country. The minimum and maximum (within a country) of the same correlation are reported in columns (6) and (7).