Export Risk and Currency Returns

November 17, 2022

Abstract

Export risk occurs when trade shocks affect expected foreign currency earnings. Economies with exports concentrated in fewer categories, are riskier than other economies. The risky economies also exhibit higher interest rates. These findings are consistent with a two-period Ricardian trade model showing a positive relation between export risk and expected currency returns in a costly production environment, where cost shocks are impactful. A hedge portfolio capturing export risk explains average excess currency returns in the cross-section. The export risk factor is negatively related to innovations in market volatility, but unlike other factors, is positively related to US dollar returns.

Key words: Export Quality, Export Concentration, Export Risk, Currency Returns.

JEL Classification: F14 (Exports), F31 (Currency Returns), F37 (Expected Returns), G12 (Cross-Sectional Asset Pricing), G15 (International Financial Markets).

1. Introduction

International trade and international finance are inextricably linked: Trading activity has a strong influence on whether the value of a nation's currency rises or falls relative to that of other currencies. However, very little is known about the connection between currency returns and the risks tied to international trade. Exports could be important when investigating currency returns and risk premia across economies, given that weaker exports lead to a weaker supply of foreign currency in most domestic economies. Export risk is also important because trade shocks can affect the exchange rate (Mendoza, 1995); and currency investors may be willing to pay a premium for economies that are more resilient to trade shocks (i.e., lower currency returns).[1]

To capture export risk, I use two measures derived from product-level international trade data: export concentration and export quality. For each economy, export concentration is a commonly used Theil measure of diversification (Papageorgiou, Spatafora, and Wang; 2015). Export concentration is negatively related to economic development (Amin Gutiérrez de Piñeres and Ferrantino, 1997; Hesse, 2009; Mau, 2016); while being positively related to economic volatility (Mobarak, 2005; Koren and Tenreyo, 2007) and political instability (Cuberes and Jerzmanowski, 2009). For each economy, export quality is defined as the export price that is unexplained by production costs, distance, or exporter income per capita (Henn et al., 2020). Export quality is positively related to economic development (Melitz, 2003; Schott, 2004; Hummels and Skiba, 2004; Hummels and Klenow, 2004; Hallak, 2006); and economies tend to

[1] Trade shocks can be defined as a net gain or loss from trade, caused by exogenous and unpredictable factors. These shocks can be decomposed into price and volume effects. Choi, Hummels, and Xiang (2009) present results which suggest that negative trade shocks are sometimes driven by recessions in partner economies. Trade shocks can be demand shocks (e.g., trade partner expenditure), supply shocks (e.g., factories destroyed by a natural disaster), or both. Trade shocks can be global and pervasive (Bems, Johnson, and Yi, 2013; Ornelas, Liu, and Shi, 2021), or bilateral and isolated. Trade shocks may even be limited to a product category (e.g., international commodity price shocks). Terms-of-trade shocks in particular can have a significant impact on an economy (Schmitt-Grohé and Uribe, 2018; Juvenal and Petrella, 2020); and firms within an economy (Greenland et al., 2020).

respond to trade shocks by improving export quality (Verhoogen, 2008, 2020). Economies with stronger export quality are also more resilient to trade shocks (Brambilla, Lederman, and Porto, 2012).[2]

By exploring a sample of 53 economies for the months October 1983 to December 2015, this paper studies whether an economy's export risk is unrelated to its excess currency returns in a standard factor model of asset pricing. I find that economies with low-quality exports, and exports concentrated in fewer categories, are riskier than other economies.[3] The risky economies also exhibit higher interest rates. Using cross-sectional empirical methods, this paper shows that an export risk factor performs very well in explaining the cross-section of currency portfolio returns. Although the export risk factor exhibits modest pairwise correlations with some currency factors, it is novel in its composition and its empirical patterns.[4]

These results provide a significant contribution to the existing literature on currency returns. Existing research shows that the fundamental risks associated with international trade and finance (Kalemli-Ozcan, Papaioannou, and Peydro, 2013; Kalemli-Ozcan, Papaioannou, and Perri, 2013) are important for determining excess currency returns (Della Corte, Riddiough, and

---

[2] In theory, specialized products of higher quality may be more susceptible to adverse demand shocks (i.e., dependent on special buyers). However, Brambilla, Lederman, and Porto (2012) show that producers of higher quality goods are better able to find alternative buyers for their products.

[3] To confirm the risk properties of export quality and export concentration, I explore (in Appendix B) the relation between sample-period output volatility and the sample-period means of the underlying annual measures of export quality and export concentration. Consistent with di Giovanni and Levchenko (2012); this paper shows a negative relation between average export quality and output volatility, and a positive relation between average export concentration and output volatility. In contrast, there is no robust relation between an economy's average forward discount and its sample-period output volatility. In addition to providing confirmatory evidence that export risk is positively related to output volatility, this paper provides new evidence that export risk is associated with greater excess currency returns.

[4] For example, the export risk factor does not merely reflect economy size or commodity intensity: Table A.2 shows that a small economy like Lithuania exhibits *less* export risk than a large economy like Mexico; while a commodity-intensive economy like Croatia exhibits *less* export risk than a finished-goods economy like Israel. Moreover, Table 8 shows that no alternative factor exhibits a pairwise correlation with the export factor that is greater than 0.50, or less than 0.50. Table 7 presents further evidence of the novelty of the export risk factor in that it is the only studied factor to exhibit a positive and significant association with US dollar returns.

Sarno, 2016; Barrot, Loualiche, and Sauvagnat. 2019).[5] Some of these risks are captured by cross-sectional differences in interest rates that drive the well-known carry trade investment strategy for international currencies (Lustig and Verdelhan, 2007; Lustig, Roussanov, and Verdelhan, 2011; Menkhoff et al., 2012).[6] By showing that export risk is positively associated with interest rates, this paper provides deeper insights into the economic risks that could drive the returns of the currency carry trade strategy.[7]

To clarify the theoretical underpinnings of the relation between export risk and expected currency returns, I present a Ricardian model of international trade (Eaton and Kortum, 2002; or EK) with two periods. Following Dumas (1992) and Hollifield and Uppal (1997), this paper's model defines the bilateral exchange rate as the relative price levels between two economies. In the model, greater trade flows reflect less export concentration and determine exchange rates. To highlight the role of trade shocks, I augment EK with production cost shocks and contract frictions.[8] In the first period, trade shares are determined using the standard EK equilibrium. Contracts are then written based on these trade shares and then fixed (a contract friction). In the second period, firms experience stochastic cost shocks, and currency returns are realized.

[5] Colacito, Riddiough, and Sarno (2020) show that the business cycle is also important for excess currency returns. In studying fundamental economic risks, Della Corte, Riddiough, and Sarno (2016) demonstrate that capital account imbalances are associated with significant excess currency returns.

[6] To implement the carry trade strategy; a portfolio manager can buy currencies associated with high interest rates, while selling currencies associated with low interest rates (Hansen and Hodrick, 1980; Fama, 1984). In Ready, Roussanov, and Ward (2017), commodity economies offer high interest rates on average, while economies that export finished goods tend to have low interest rates.

[7] Richmond (2019) argues that trade network centrality is related to interest rate differentials and currency risk premia. The author shows that centralized economies are more exposed to global consumption growth, while peripheral economies are less exposed, thus highlighting fundamental economic risks. On the first page of the paper, Richmond writes "Although the returns to carry trade strategies are well studied, less is known about their economic origins…. By connecting returns to economic quantities, I shed light on the fundamental origins of exposure to risk that drives international asset prices. Consistent with the idea, Hassan et al. (2021) shows that trade agreements for peripheral economies often result in lower currency returns.

[8] As early as Zarnowitz (1962), there has been a rich literature studying the role of supply shocks in aggregate phenomena. This paper's model focuses on the role of fixed contracts (Carlton, 1979) in international trade, where unfilled orders are often characterized as delivery lags (Kydland and Prescott, 1982). Due to the Covid-19 pandemic, these supply chain disruptions have become increasingly important in recent years (Meier and Pinto, 2020).

The key assumption of the model is one of differential contract fulfilment: International (export) contracts can go unfilled while domestic contracts are always filled.[9] Given that domestic contracts are always filled, the change in exchange rates—and therefore currency returns—between the two periods, is a function of the change in trade shares.

In the presence of trade shocks, trade shares in the second period follow an extreme-value distribution. Exporting firms will either meet or fall short of contract terms, and trade shares are expected to fall on average. Moreover, the change in trade shares between the two periods is either negative or zero representing an "option-like" payoff. The model shows that when input costs are sufficiently high, there is a positive relation between export concentration and expected currency returns in the first period.

When empirically investigating the relation between export concentration and excess currency returns, I distinguish between the intensive margin (the concentration within export product categories) and the extensive margin (the concentration in fewer export product categories). I find that export concentration is associated with greater excess currency returns, and the relation is largely driven by the extensive margin of export concentration. When investigating currency portfolios sorted on the extensive margin of export concentration; a hedge portfolio that is long on concentrated economies and short on diversified economies, produces an average annual excess return of approximately 3.6%.

Informed by the initial portfolio summary statistics, I construct a combined measure of export risk as the extensive margin of export concentration divided by export quality (i.e., a quality adjusted measure of export concentration).[10] When investigating currency portfolios

[9] This assumption is partly motivated by the fact that the international law surrounding unfilled orders contains gaps that are less prevalent in domestic jurisdictions (Rapsomanikis, 1980; Lee, 1990; Jenkins, 1998; Hart, 2022).

[10] When currency portfolios are sorted on export quality; a hedge portfolio that is long on lower quality economies and short on higher quality economies, produces an average annual excess return of roughly 3.6%.

sorted on the combined measure of export risk; a hedge portfolio that is long on riskier economies and short on safer economies, produces an average annual excess return of roughly 4%. The finding is robust when limiting the analysis to higher-income economies that are less likely to peg their currencies.[11]

Do these hedge portfolio returns represent greater risk or mispricing? Two empirical facts suggest that the hedge portfolio returns represent a compensation for export risk: First, consistent with the idea that greater returns are associated with economies with greater *exposure* to export risk, the average excess currency return increases with a portfolio's average *exposure* to export risk (i.e., portfolios sorted on exposures). Second, the returns for the hedge portfolio (i.e., the export risk factor, TRAD) decrease with positive innovations in market volatility.

Upon further investigation of one possible economic mechanism behind the export risk factor, I find a positive relation between TRAD and United States (US) dollar returns. In other words, economies with greater export risk do relatively well when US dollar returns are high. Given that the US is a large global net importer, the finding is consistent with the idea that domestic risky exports are more likely to pay off when foreign importers exhibit stronger purchasing power.[12]

The factor structure of the export risk portfolios (Q1 to Q5) and the corresponding pricing performance of the export risk factor (Q5 – Q1, or TRAD) together present a consistent and compelling story. Two principal components, or factors, capture roughly 89% of the variation for the five export risk portfolios. The pattern for the dominant "level" factor is noteworthy:

---

[11] For the full sample of economies, the export risk hedge portfolio (Q5 – Q1) captures the following cases where there was a pre-announced peg or currency board arrangement (Ilzetzki, Reinhart, and Rogoff, 2019): Q5 includes Hong Kong for the years 1984 to 1996; while Q1 includes Denmark in 2010, Malaysia in 2005, and Lithuania for the years 2004 and 2009 to 2014. For the sample of higher-income economies, the export risk hedge portfolio contains no cases where there was a pre-announced peg or currency board arrangement.

[12] This is also consistent with the idea that negative trade shocks are sometimes driven by recessions in partner economies (Choi, Hummels, and Xiang, 2009).

Average excess returns decrease from Q1 to Q5. The finding is consistent with a negative exposure to US dollar returns (Lustig, Roussanov, and Verdelhan, 2011). Moreover, TRAD is negatively correlated with the conditional dollar factor (DOL; Verdelhan, 2018); and positively correlated with the carry trade factor (CAR).

This paper's cross-sectional asset pricing tests use 30 test portfolios to investigate the pricing performance of the export risk factor where factor prices and loadings are estimated using a generalized method of moments (GMM) empirical approach (Hansen, 1982). When coupled with the conditional dollar factor (DOL), the export risk factor does extremely well in explaining the cross-section of excess currency returns. The proposed model (DOL + TRAD) does just as well in explaining average excess currency returns in the cross-section as a benchmark model with the carry trade factor (DOL + CAR). In addition, the pricing kernel is consistently characterized under three different weighting matrices (identity, Hansen-Jagannathan, and optimal).

Overall, the empirical findings suggest that export risk is captured in the international currency market. The evidence is consistent with a framework where currency investors are willing to pay a premium for economies that are more resilient to trade shocks.[13] Apropos, a two-factor pricing model (DOL + TRAD) motivated by fundamental international economic risk, does very well in explaining the cross-section of excess currency returns.

---

[13] The main empirical result is also consistent with theoretical models of international asset pricing. In particular, a model with trade costs can be shown to generate currency risk premia around cross-sectional differences in interest rates (Hollifield and Uppal, 1997). Using a two-economy model, Hollifield and Uppal (1997) show that currency risk premia are associated with the marginal product of capital (i.e., productivity) and the volatility of capital shocks in both economies. Hollifield and Uppal (1997) argue that "the effect of segmentation of … markets on the relation between real exchange rate changes and the real interest rate differential can be interpreted in … terms of the risk premium for capital imbalances across countries." Ready, Roussanov, and Ward (2017) explore the role of asymmetric productivity to show that, compared to other economies, economies with greater productivity tend to exhibit lower excess currency returns. Imbs and Wacziarg (2003) argue that economies with greater export risk can be characterized as economies with less productivity. Therefore, in a model of international asset pricing with trade costs (e.g., Hollifield and Uppal, 1997), economies with greater export risk are likely to exhibit greater excess currency returns.

2. Motivation and Hypothesis Development

Economies with an abundance of natural resources, often experience slower economic growth and less development compared to other economies. This "resource curse" is one of the most studied topics in development (Ross, 2015); and its root causes can be political as well as economic.

In recent years, policymakers began to link international price shocks to poor outcomes in resource-dependent economies. For example, the United Nations Conference on Trade and Development (UNCTAD) in April 2019 convened a panel of experts who urged leaders in resource-dependent economies to diversify exports because of the adverse effects of international price volatility.[14] The UNCTAD Deputy Secretary-General Isabelle Durant spoke plainly when delivering her remarks:

> "*Heavy dependence on commodities makes these countries vulnerable to shocks and price fluctuations.*"

The strong policy stance emerged after numerous episodes where falling international commodity prices wreaked havoc on many lower-income economies, one of which being Angola where oil constituted roughly 95% of export earnings.[15] When a decadelong oil price boom ended in 2014, Angola held a special cabinet meeting to discuss the economy's problems. The meeting participants noted the large decrease in foreign currency availability because of the fall in oil prices. This resulted in the devaluation of Angola's currency and double-digit inflation figures.[16]

---

[14] Multiyear Expert Meeting on Commodities and Development, 11th Session, 15 - 16 April 2019, Geneva, Switzerland.

[15] Cristina Maza, "Can Developing Petrostates Learn to Live without Oil?," *The Christian Science Monitor*, March 25, 2016.

[16] See "Angola - Economic Crisis Tops Debate At Parliament," *AngolaPress*, March 4, 2016; and Kanika Saigal, "Angola's De-Dollarization Drive," *Euromoney*, September 24, 2015.

The experience of resource-dependent economies suggests a fundamental link between export risk and excess currency returns. Trade shocks can shift the supply of foreign exchange in an economy; and currency investors may be willing to pay a premium for economies that are more resilient to trade shocks. To determine the role of export risk in excess currency returns, this paper studies excess currency returns in a standard factor model of asset pricing.

Although various studies show the role of exports in economic risk (Koren and Tenreyo, 2007; Brambilla, Lederman, and Porto, 2012), there is no prior study that explores the link between export risk and excess currency returns. The research question therefore remains unanswered: Is export risk related to excess currency returns? For the question to have an affirmative answer, international currency markets should aggregate, and process, relevant trade information efficiently; and trade resilience should matter for excess currency returns. To study the question, this paper uses data from multiple sources.

3. Data and Sample Statistics

For a sample of economies over the months October 1983 to December 2015, this paper studies the relation between an economy's export risk and its end-of-month excess currency returns. Following Della Corte, Riddiough, and Sarno (2016), I use an initial sample of 55 currencies inclusive of the euro. Given the imprecision surrounding the estimation of export risk for euro economies, the final sample excludes the euro, and consists of 53 economies with non-missing values for the measures of export risk. Each economy that adopts the euro is removed from the sample on the adoption date. Following Lustig, Roussanov, and Verdelhan (2011) and Della Corte, Riddiough, and Sarno (2016); monthly observations that violate covered interest rate parity (CIP) are also removed from the sample. The list of sample economies, variable descriptions, and data sources, are presented in Appendix A. The final sample consists of 10709 economy-month observations. The summary statistics are presented in Table 1.

3.1 Exchange Rates and Excess Currency Returns

Foreign spot exchange rates and one-month forward exchange rates for the United States (US) dollar (i.e., the domestic currency) are extracted from the Datastream database maintained by Refinitiv (Thomson Reuters). *Excess return* is the monthly return to buying a foreign currency in the forward market (at the forward rate) at time t and then selling it in the spot market (at the spot rate) at time $t + 1$. The mean for *Excess return* is approximately 26.5 basis points. *Forward discount* is the discount of the forward rate to the spot rate at time t (expressed as a percentage of the forward rate). The mean for *Forward discount* is roughly 27.2 basis points. *Spot return* is the monthly return to buying a foreign currency in the spot market at time t and then selling it in the spot market at time $t + 1$ (expressed as a percentage of the forward rate). The mean for *Spot return* is approximately -4 basis points.

3.2 Export Risk

This paper primarily uses an export-quality-adjusted measure of export concentration as a proxy for export risk. The measure consists of two components: export quality (Henn et al., 2020) and export concentration (Papageorgiou, Spatafora, and Wang; 2015). The annual data used for both components are extracted from the Export Quality and Diversification database maintained by the International Monetary Fund (IMF). *Export quality* is a measure of export quality, defined as the export price that is unexplained by production costs, distance, or exporter income per capita.[17] The mean for *Export quality* is roughly 0.94. *Export concentration intensive* is a within-Theil (intensive) measure of export concentration referring to the concentration of export

[17] Trade economists use a number of methods to measure quality. Yue (2021) presents a unified approach that clarifies the identifying assumptions needed to extract quality variation from the data using each method.

volumes within product categories.[18] The mean for *Export concentration intensive* is approximately 2.08. *Export concentration extensive* is a between-Theil (extensive) measure of export concentration reflecting the concentration of export volumes in fewer product categories. The mean for *Export concentration extensive* is roughly 0.16. *Export concentration total* is an overall Theil measure of export concentration; and is the sum of the intensive and extensive components. The mean for *Export concentration total* is approximately 2.23. *Export risk* is *Export concentration extensive* divided by *Export quality*.

3.3 Currency Portfolios

To study the relation between an economy's export risk and its end-of-month excess currency returns, I construct currency portfolios on the basis of the various export measures. At the end of every year, currencies are allocated to portfolio quintiles based on a given export measure. The currencies with the lowest expected returns (i.e., stronger export quality, weaker export concentration, less export risk) are allocated to Quintile 1 (Q1), while the currencies with the greatest expected returns (i.e., weaker export quality, stronger export concentration, greater export risk) are allocated to Quintile 5 (Q5). I also construct hedge portfolios for each export measure (i.e., Q5 – Q1).

3.3.1. *Test Assets*

This paper uses 30 test portfolios to study the pricing performance of various currency factors. In addition to the five portfolios for *Export concentration total*, and the five portfolios for *Export quality*; I also construct five portfolios for the currency carry trade, five portfolios for currency momentum, five portfolios for net foreign assets, and five portfolios for locally denominated

[18] Papageorgiou, Spatafora, and Wang (2015) explore three product categories: traditional, non-traded, and new. The authors define traditional products as goods that were exported at the start of their sample period; non-traded products as goods with zero exports for the entire sample period; and new products as goods that began exporting after at least two years since the start of the sample period.

credit.

The five portfolios for the carry trade are constructed on the basis of *Forward discount* values. At the end of every month, currencies are allocated to portfolio quintiles. The currencies with the smallest forward discounts (or lowest interest rate difference relative to the US) are assigned to Q1, whereas currencies with the greatest forward discounts (or highest interest rate difference relative to the US) are assigned to Q5.

The five portfolios for currency momentum are constructed on the basis of lagged 24-month returns. At the end of every month, currencies are allocated to portfolio quintiles. The currencies with the smallest lagged returns are assigned to Q1, whereas currencies with the greatest lagged returns are assigned to Q5.

The five portfolios for net foreign assets are constructed on the basis of the ratio of net foreign assets to GDP (Lane and Milesi-Ferretti, 2007). At the end of every year, currencies are allocated to portfolio quintiles. The currencies with the smallest ratio of net foreign assets to GDP are assigned to Q1, whereas currencies with the greatest ratio of net foreign assets to GDP are assigned to Q5.

The five portfolios for locally denominated credit are constructed on the basis of the percentage of locally denominated foreign debt (Benetrix, Lane and Shambaugh, 2015). At the end of every year, currencies are allocated to portfolio quintiles. The currencies with the greatest percentage of locally denominated credit are assigned to Q1, whereas currencies with the smallest percentage of locally denominated credit are assigned to Q5.

3.3.2. *Currency Factors*

This paper compares the hedge portfolio for export risk (i.e., Q5 – Q1), or the trade factor (TRAD), to other currency factors. The carry trade factor (CAR) is the hedge portfolio for the carry trade. The momentum factor (MOM) is the hedge portfolio for currency momentum. Following Della Corte, Riddiough, and Sarno (2016), I construct a global imbalance factor (IMB) using the currency portfolios for net foreign assets and locally denominated credit. Finally, the conditional dollar factor (DOL) is taken from Verdelhan (2018); the economy size factor (SIZE) from Hassan (2013); the commodity carry factor (IMR) from Ready, Roussanov, and Ward (2017); and the trade centrality factor (CENT) from Richmond (2019).

3.4 The Economy

The national-accounts data used for output volatility are extracted from the Penn World Tables (PWT) version 9.1, and the 2019 World Development Indicators (WDI) database maintained by the World Bank. *Economic growth*, the annual growth rate of real GDP per capita, is constructed as follows: First, by using the corresponding indicator from the WDI database; and second, where the data are missing in the WDI database, by using the corresponding indicators from the PWT for calendar-year reporting economies. The variable is then winsorized at the 1% level to lessen the effect of extreme values. *Output volatility* is the sample period standard deviation for *Economic growth*.

4. Empirical Methods and Analysis of Currency Returns

This paper uses cross-sectional empirical methods to determine whether an economy's export risk is unrelated to its excess currency returns in a standard factor model of asset pricing.

[1] $$R_{it}^{e} = a_i + \boldsymbol{\beta}_{it}' \cdot \mathbf{f}_t + u_{it}$$

To test the hypothesis, this paper employs a currency portfolio approach. Portfolios of currencies are constructed based on export measures. The properties of these portfolios are then studied to determine whether export risk is priced in a standard factor model (Ross, 1976).

4.1 Currency Portfolio Summary Statistics

Table 2 presents the summary statistics of currency portfolios sorted on export measures for all economies in Panel A, and for higher-income economies in Panel C.[19] In Panels A and C of Table 2, the first row shows the average excess returns of currency portfolios Q1 to Q5 for *Export concentration total*, in addition to the average excess returns for the Q5 – Q1 hedge portfolio. Consistent with the idea that economies with stronger export concentration exhibit greater returns, the average excess currency return increases with a portfolio's average export concentration. However, the relation is not uniform. The annualized average excess return for the hedge portfolio is approximately 1% for all economies (Panel A) and 0.5% for higher-income economies only (Panel C).

In Panels A and C of Table 2, rows (3) and (5) show that the positive relation between a portfolio's average export concentration and its average excess return is mostly driven by the portfolio's average extensive margin of export concentration. Row (5) shows the average excess returns of currency portfolios Q1 to Q5 for *Export concentration extensive*. Consistent with the idea that greater returns are associated with economies that exhibit a greater concentration of export volumes in fewer product categories, the average excess currency return increases with a portfolio's average extensive margin of export concentration. The annualized average excess return for the hedge portfolio is roughly 3.6% for all economies (Panel A) and 3.3% for higher-income economies only (Panel C).

In Panels A and C of Table 2, row (7) shows the average excess returns of currency portfolios Q1 to Q5 for *Export quality*. Consistent with the idea that economies with weaker export quality exhibit greater returns, the average excess currency return decreases with a portfolio's average export quality. The annualized average excess return for the hedge portfolio

[19] See Appendix A for the list of higher-income economies used in this paper.

is approximately 3.6% for all economies (Panel A) and 2.9% for higher-income economies only (Panel C).

In Panels A and C of Table 2, the findings in rows (5) and (7) suggest that two export measures are important for export risk: *Export concentration extensive* and *Export quality*. Therefore, I construct *Export risk* as a quality-adjusted measure of export concentration (*Export concentration extensive* divided by *Export quality*). The measure recognizes the inherent risk associated with export concentration while acknowledging that an economy's exports are likely to vary in export quality.

In Panels A and C of Table 2, row (9) shows the average excess returns of currency portfolios Q1 to Q5 for *Export risk*. For the Q1 and Q5 export risk portfolios; Table A.2 in Appendix A presents a list of economies, and the associated percentage of sample returns.[20] Consistent with the idea that economies with greater export risk exhibit greater returns, the average excess currency return increases with a portfolio's average export risk. The annualized average excess return for the hedge portfolio is roughly 4% for all economies (Panel A) and 3.4% for higher-income economies only (Panel C). For all economies in Panel B of Table 2, the reward-risk ratio of the hedge portfolio is roughly 0.50, which suggests that the hedge portfolio has reasonable risk-adjusted returns.

Taken together, the findings in Table 2 suggest that there is a positive and significant relation between an economy's export risk and its monthly currency returns.

4.2 The Return Recognition of Export Risk

Although the findings in Table 2 suggest that there is a positive relation between export risk and currency risk premia, the manner in which export risk is recognized in currency returns is unclear. Lustig, Roussanov, and Verdelhan (2011) show that excess currency returns can be

[20] See fn.11.

decomposed into forward discounts and spot returns.[21] The authors also show a significant positive relation between average forward discounts and currency portfolio returns.[22] To determine how export risk is recognized in excess currency returns; Table 3 shows cross-sectional regressions for the economy-month observations in the sample.

In Table 3, columns (1) to (3) present the results of a cross-sectional regression where coefficients for each (monthly) time period are recorded then averaged to produce the final results (Fama and MacBeth, 1973). Column (3) shows that export risk is largely recognized in the forward discount component of excess returns: There is a positive relation between the extensive margin of export concentration and the forward discount. The coefficient is approximately 0.36 and is statistically significant at the 1% level. In addition, there is a negative relation between export quality and the forward discount. The coefficient is roughly -3.26 and is statistically significant at the 1% level.

In Table 3, columns (4) to (6) present the results of a between-effects (BE) panel regression where the right-hand-side (RHS) variables for each (monthly) time period are first averaged to produce the cross-sectional estimates. Column (6) shows that average export risk is largely recognized in the forward discount component of average excess returns: There is a positive relation between the mean extensive margin of export concentration and the average forward discount. The coefficient is approximately 7.88 and is statistically significant at the 1% level. In addition, there is a negative relation between average export quality and the average forward discount. The coefficient is roughly -12.24 and is statistically significant at the 1% level.

Taken together, the findings in Table 3 suggest that the positive relation between the average forward discount and future monthly excess currency returns, may in part occur because

---

[21] In this paper, *Spot return* ($t + 1$) = *Excess return* ($t + 1$) - *Forward discount* (t).

[22] In Appendix B, Table B.2 shows the relation between average forward discounts and portfolio returns for this paper's sample.

of export risk; with currency traders acknowledging export risk in forward discount values (i.e., *expected* currency returns).

4.3 Export Risk and Market Volatility

Although the findings in Table 2 suggest that there is a positive relation between export risk and currency risk premia, it is unclear whether the returns of the export-risk hedge portfolio (or export risk factor, TRAD) provide compensation for risk. Lustig, Roussanov, and Verdelhan (2011) and Menkhoff et al. (2012) show that carry trade portfolio returns are negatively related to market volatility, thus providing some compensation for risk. To determine whether the export risk factor provides some compensation for market volatility risk; Table 4 presents time series regressions of the TRAD factor on innovations in market volatility indices.

In Table 4, column (1) shows the results of a regression of TRAD on innovations in an index for equity market volatility (VIX). Consistent with the idea that export risk portfolio returns provide some compensation for risk, TRAD decreases with positive innovations in the VIX. The coefficient is approximately -0.10 and is statistically significant at the 1% level. Column (2) shows that TRAD also decreases with positive innovations in JP Morgan's index for foreign exchange market volatility (VXY). The coefficient is roughly -0.26 and is statistically significant at the 5% level.

Taken together; the findings in Table 4 suggest that the positive relation between an economy's export risk and its monthly currency returns, provides some compensation for the risk associated with market volatility.

4.4 Currency Portfolios Sorted on Betas

Although the findings in Table 2 suggest that there is a positive relation between export risk and currency risk premia, it is unclear whether the relation is consistent with greater exposure to a return factor. To determine whether the relation is driven by greater factor exposure; I construct currency portfolios based on rolling 24-month hedge-portfolio exposures—or betas—for *Export concentration extensive*, *Export quality*, and *Export risk*.

In Table 5, row (1) shows the average excess returns of currency portfolios Q1 to Q5 for *Export concentration extensive* beta. Consistent with the idea that greater returns are associated with economies with greater exposure to the risk of export concentration, the average excess currency return increases with a portfolio's average exposure to the extensive margin of export concentration. The annualized average excess return for the hedge portfolio is roughly 2%.

In Table 5, row (3) shows the average excess returns of currency portfolios Q1 to Q5 for *Export quality* beta. Consistent with the idea that economies with weaker exposure to export quality exhibit greater returns, the average excess currency return decreases with a portfolio's average exposure to export quality. The annualized average excess return for the hedge portfolio is approximately 3%.

In Table 5, row (5) shows the average excess returns of currency portfolios Q1 to Q5 for *Export risk* beta. Consistent with the idea that greater returns are associated with economies with greater exposure to export risk, the average excess currency return increases with a portfolio's average exposure to export risk. The annualized average excess return for the hedge portfolio is roughly 1.9%.

Taken together, the findings in Table 5 suggest that there is a positive and significant relation between an economy's export risk exposure and its monthly excess currency returns.

4.5 <u>The Principal Components of Currency Portfolios</u>

The findings in Tables 2 and 5 suggest that there is a positive relation between export risk and currency risk premia consistent with a model of factor exposure. Nevertheless, the general factor exposure of the export-risk portfolios has yet to be determined. In Table 6, I investigate the principal components of the currency portfolios sorted on *Export concentration extensive*, *Export quality*, and *Export risk*. Each panel shows the loadings on the principal components in addition to the total variance of returns linked to each principal component.

Panel A of Table 6 shows the principal components of the currency portfolios sorted on *Export risk*. Roughly 89% of the variation for the five portfolios can be explained by two principal components. The first principal component (PC1) explains approximately 78% of the common variation in portfolio returns. The second principal component (PC2) explains roughly 11% of the common variation in portfolio returns. PC2 seems to be the only risk factor that could explain the cross-section of portfolio returns given that the average excess returns increase from Q1 to Q5 with a particularly sharp increase from Q4 to Q5. The remaining principal components do not exhibit a similar pattern in loadings. The pattern for PC1 is noteworthy: Average excess returns decrease slightly from Q1 to Q4 with a more pronounced reduction from Q4 to Q5. Given that PC1 is often described as a level factor—or the average foreign currency return—the finding suggests that the export-risk hedge portfolio may exhibit a negative exposure to the "level" factor (Lustig, Roussanov, and Verdelhan, 2011).

Panel B of Table 6 shows the principal components of the currency portfolios sorted on *Export concentration extensive*; and exhibits similar results to the principal components in Panel A. Panel C of Table 6 shows the principal components of the currency portfolios sorted on *Export quality*. In contrast to the mostly monotonic variation for PC1 and PC2 presented in Panels A and B, the variation in PC1 and PC2 is non-monotonic. The finding suggests that a risk factor constructed from the export-quality hedge portfolio is unlikely to explain the cross-section of portfolio returns.

Taken together, the findings in Table 6 suggest that the general factor exposure of the export-risk portfolios is largely captured by the extensive margin of export concentration; and the exposure can be characterized by two factors.

4.6 The Role of US Dollar Returns

The results in Table B.1, along with Figures B.1 and B.2 (in Appendix B), suggest that export risk is positively related to output volatility. In addition, the results in Panel A of Table 6 suggest that the export-risk hedge portfolio may exhibit a negative exposure to the "level" factor (the average foreign currency return). These findings are consistent with the idea that economies with greater export risk do poorly when foreign currency returns are high and US dollar returns are low.[23] To clarify the role of US dollar returns; Table 7 presents time series regressions of currency factors on monthly US dollar returns (against a basket of currencies; Verdelhan, 2018).

In Panel A of Table 7, column (1) shows a regression of the conditional dollar factor (DOL) on US dollar returns. Verdelhan (2018) shows that when investigating changes in exchange rates (expressed as value per US dollar); economies with greater exposure to dollar returns—controlling for the average forward discount—exhibit greater excess currency returns. The conditional dollar factor is the hedge portfolio associated with the conditional dollar beta. Given its construction, DOL is supposed to exhibit lower excess returns as the US dollar appreciates. Column (1) confirms the relation. The coefficient is approximately -0.79 and is statistically significant at the 1% level.

Column (2) shows a regression of the global imbalance factor (IMB) on US dollar returns. Della Corte, Riddiough, and Sarno (2016) show that economies with greater net foreign assets and greater liabilities denominated in non-local currency, exhibit greater excess currency

[23] The findings of Gopinath et al. (2020) suggest that there may also be a feedback loop between US dollar returns and trade risk.

returns. The global imbalance factor is the hedge portfolio associated with these foreign commitments. Given its construction, IMB is supposed to exhibit lower excess returns as the US dollar appreciates (i.e., more expensive commitments). Column (2) confirms the relation. The coefficient is roughly -0.34 and is statistically significant at the 1% level.

Column (3) shows a regression of the carry trade factor (CAR) on US dollar returns. Lustig, Roussanov, and Verdelhan (2011) show that each foreign-discount portfolio exhibits roughly the same loading on the "level" factor (i.e., average foreign currency return). Therefore, CAR is supposed to be hedged against changes in the US dollar. Column (3) confirms the relation. The coefficient is approximately 0.10 and not statistically significant.

In Panel A of Table 7, columns (1) to (3) present results that are consistent with the construction of each hedge portfolio (DOL, IMB, and CAR). Column (4) shows a regression of the export risk factor (TRAD) on US dollar returns. The fundamental economic risk associated with exporting is that trade flows fall short of expectations.[24] The US is the largest importer in the world. Therefore, TRAD is supposed to exhibit greater excess returns as the US dollar appreciates (as Americans are able to buy a greater amount of exports from other economies). Column (4) confirms the relation. The coefficient is roughly 0.45 and is statistically significant at the 1% level.

In Panel B of Table 7, columns (1) to (3) present the results of regressions of additional currency factors (CENT, SIZE, and IMR) on US dollar returns. The findings suggest that the positive and significant relation between TRAD and the US dollar return is novel; none of these additional currency factors exhibits a similar significant relation.

Taken together, the findings in Table 7 suggest that the fundamental economic risk associated with exporting is that trade flows fall short of expectations. The theoretical model in

[24] See fn. 12.

Section 5 explores the phenomenon in the presence of trade shocks.

4.7 Pairwise Correlations of Currency Factors

Table 8 presents the pairwise correlations for various currency factors (TRAD, CENT, SIZE, IMR, DOL, CAR, IMB, and MOM). The export risk factor, TRAD, is positively correlated with the trade centrality factor (CENT), the size factor (SIZE), the commodity carry factor (IMR), and the carry trade factor (CAR). TRAD is negatively correlated with the conditional dollar factor (DOL). However, none of these pairwise correlations is greater than 0.50 or less than 0.50. In addition, the pairwise correlations for the global imbalance factor (IMB) and the currency momentum factor (MOM) are not statistically significant at 5% or less. Given these factor correlations, Table 9 proceeds with cross-sectional tests of asset pricing performance.

4.8 Pricing Performance

This paper's cross-sectional asset pricing tests use 30 test portfolios to investigate the pricing performance of the export risk factor. Consider the data generating process for excess currency returns in [1]. In addition, let *i=1,…,N* be an index for the test portfolios. In the absence of arbitrage, excess returns are adjusted for risk using a stochastic discount factor (SDF), M_t; thus satisfying the following Euler equation:

[2] $$E_t[M_{t+1}R^e_{it+1}] = 0$$

The SDF can be represented as linear in the pricing factors where b is a vector of factor loadings; and μ_{f} is a vector of factor means.

[3] $$M_{t+1} = 1 - b'(\mathbf{f}_{t+1} - \mu_{\mathrm{f}})$$

This linear representation is consistent with a beta pricing model where the expected excess return is equal to the factor price λ times the beta of each test portfolio.

[4] $$E[R^e_i] = \lambda'\beta_i$$

$$\lambda = \Sigma_f b$$

Here Σ_f is the variance-covariance matrix of the factors.

The factor prices λ and loadings b are estimated using a generalized method of moments (GMM) empirical approach (Hansen, 1982), with unconditional moments and a singular instrument vector. The GMM approach requires a specified weighting matrix that determines the weight for each moment condition (Hodrick and Zhang, 2001; Hansen and Jagannathan, 1997). This paper presents the results for three different weighting matrices: the identity matrix (one-step estimation), the Hansen-Jagannathan (HJ) weighting matrix (one-step estimation), and the optimal weighting matrix (two-step estimation).

The identity matrix attempts to price all portfolios equally well. The HJ matrix essentially standardizes all portfolios for a comparison across alternative SDF proxies; and allows for a measure of the distance between a true SDF that prices all assets (HJ distance), and the implied SDF proxy in a given empirical model. The optimal matrix assigns large weights to portfolios with small variances in their pricing errors (and small weights to portfolios with large variances of their pricing errors). Although the optimal matrix produces the most efficient estimates, it does not allow for a uniform measure of performance across models for a common set of portfolios. The identity matrix and the HJ matrix allow for a uniform measure of performance.

4.8.1. *Empirical Results*

Table 9 presents the results of the cross-sectional asset pricing tests using the following 30 test portfolios: 5 carry trade portfolios, 5 momentum portfolios, 10 global imbalance portfolios (5 sorted on the net foreign asset position, and 5 on the share of foreign liabilities in local currency), 5 export quality portfolios, and 5 export concentration (total) portfolios. For each specification (or model), the table reports estimates of λ and b, along with standard errors and *p*-values based on Newey and West (1987) with optimal lag selection. Each model's performance is evaluated using the cross-sectional adjusted R^2 and the HJ distance measure. Following Jagannathan and Wang (1996), this paper uses simulated p-values to test whether the HJ distance is statistically significant.

Panel A presents the results of a benchmark pricing model with the conditional dollar factor (DOL) and the carry trade factor (CAR). Rows (1) and (2) show that for the identity matrix; the loading for DOL is approximately 0.03 and is not statistically significant, while the loading for CAR is roughly 0.15 and is statistically significant at the 1% level. The factor price for DOL is approximately 0.44 and is not statistically significant, while the factor price for CAR is roughly 0.84 and is statistically significant at the 1% level. Rows (3) and (4) show that for the HJ matrix; the loading for DOL is approximately 0.01 and is not statistically significant, while the loading for CAR is roughly 0.17 and is statistically significant at the 1% level. The factor price for DOL is approximately 0.24 and is not statistically significant, while the factor price for CAR is roughly 0.94 and is statistically significant at the 1% level. The cross-sectional adjusted R^2 is approximately 0.63 and the HJ distance measure is roughly 0.52 with a simulated p-value of approximately 0.26. Although the model does well in explaining average excess currency returns in the cross section, conditional dollar risk does not seem to play a strong role in the pricing kernel.

Panel B presents the results of a pricing model with the conditional dollar factor (DOL) and the global imbalance factor (IMB). Rows (1) and (2) show that for the identity matrix; the loading for DOL is approximately 0.04 and is not statistically significant, while the loading for IMB is roughly 0.09 and is statistically significant at the 1% level. The factor price for DOL is approximately 0.45 and is not statistically significant, while the factor price for IMB is roughly

0.61 and is statistically significant at the 1% level. Rows (3) and (4) show that for the HJ matrix; the loading for DOL is approximately 0.06 and is statistically significant at the 5% level, while the loading for IMB is roughly 0.05 and is not statistically significant. The factor price for DOL is approximately 0.68 and is statistically significant at the 1% level, while the factor price for IMB is roughly 0.40 and is not statistically significant. The cross-sectional adjusted R^2 is approximately 0.12 and the HJ distance measure is roughly 0.63 with a simulated p-value of approximately 0.18. Compared to the benchmark model in Panel A (DOL + CAR), the model in Panel B (DOL + IMB) does poorly in explaining average excess currency returns in the cross-section. In addition, the pricing kernel is not consistently characterized under the identity matrix and the HJ matrix.

Panel C presents the results of a pricing model with the conditional dollar factor (DOL) and the trade centrality factor (CENT). Rows (1) and (2) show that for the identity matrix; the loading for DOL is approximately 0.05 and is not statistically significant, while the loading for CENT is roughly 0.10 and is not statistically significant. The factor price for DOL is approximately 0.46 and is not statistically significant, while the factor price for CENT is roughly 0.30 and is not statistically significant. Rows (3) and (4) show that for the HJ matrix; the loading for DOL is approximately 0.08, while the loading for CENT is roughly 0.11. Both loadings are statistically significant at the 5% level. The factor price for DOL is approximately 0.72, while the factor price for CENT is roughly 0.32. Both factor prices are also statistically significant at the 5% level. The cross-sectional adjusted R^2 is approximately -0.01 and the HJ distance measure is roughly 0.63 with a simulated p-value of approximately 0.19. Compared to the benchmark model in Panel A (DOL + CAR), the model in Panel C (DOL + CENT) does poorly in explaining average excess currency returns in the cross-section. However, both factors seem to play a role in the pricing kernel when using the HJ matrix.

Panel D presents the results of a pricing model with the conditional dollar factor (DOL) and the export risk factor (TRAD). Rows (1) and (2) show that for the identity matrix; the loading for DOL is approximately 0.20, while the loading for TRAD is roughly 0.27. Both loadings are statistically significant at the 1% level. The factor price for DOL is approximately 1.43, while the factor price for TRAD is roughly 0.83. Both factor prices are also statistically significant at the 1% level. Rows (3) and (4) show that for the HJ matrix; the loading for DOL is approximately 0.20, while the loading for TRAD is roughly 0.26. Both loadings are statistically significant at the 1% level. The factor price for DOL is approximately 1.38, while the factor price for TRAD is roughly 0.82. Both factor prices are also statistically significant at the 1% level. The cross-sectional adjusted R^2 is approximately 0.53 and the HJ distance measure is roughly 0.58 with a simulated p-value of approximately 0.36. Compared to the benchmark model in Panel A (DOL + CAR), the model in Panel D (DOL + TRAD) does just as well in explaining average excess currency returns in the cross-section. In addition, the pricing kernel is consistently characterized under all three weighting matrices.

Figure 1 shows the performance of CAR betas in explaining average excess currency returns for the 30 test portfolios, while Figure 2 shows the performance of TRAD betas in explaining average excess currency returns for the same 30 test portfolios. Consistent with the findings in Table 9, Figures 1 and 2 show that compared to the carry trade factor, the export risk factor does just as well in explaining average excess currency returns in the cross-section.

Overall, the findings in Table 9 suggest that when combined with the conditional dollar factor, the export risk factor performs very well in explaining the cross-section of currency portfolio returns.

5. A Model of Export Risk and Expected Currency Returns

To illuminate the theoretical underpinnings of export risk, I construct a model of expected currency returns where both export concentration and the exchange rate are derived from a Ricardian model of international trade (Eaton and Kortum, 2002; or EK).[25] In the EK model, there is a continuum of goods that are traded under different levels of technology in multiple economies. This paper's model augments EK with production cost shocks and contract frictions.[26] Although the EK model is a static (or one-period) model, I use an additional period to study the relation between export risk and expected currency returns.

5.1 Model Structure and Assumptions

Consider a Ricardian model with two dates t = 1, 2. In the first period, trade shares are determined using the standard EK equilibrium. Contracts are then written based on these trade shares and then fixed (a contract friction). In the second period, firms experience stochastic cost shocks, and currency returns are realized. The key assumption of the model is one of differential contract fulfilment: International (export) contracts can go unfilled while domestic contracts are always filled.[27]

5.2 Economies and Price Competition

Trade shares in the first period are determined using the standard EK model. There are N economies where each economy at time t = 1 produces good $j \in [0,1]$ with efficiency $z_{i,1}(j)$. The input cost in economy i at time t = 1 is $c_{i,1}$. Under constant returns to scale, the cost of producing a unit of good j in economy i at time t =1 is $c_{i,1}/z_{i,1}(j)$. There is also a time-invariant "iceberg" trade cost $d_{ni} > 1$ associated with exporting a unit of good j from economy

[25] An important empirical prediction of the Ricardian model is that economies should export relatively more in sectors in which they are relatively more productive (Costinot, Donaldson, and Komunjer, 2012; Costinot and Donaldson, 2012).

[26] See fn.8.

[27] See fn.9.

i to economy n $(\neq i)$.[28] The total cost of producing and exporting a unit of good j from economy i to economy n at time t = 1 is $p_{ni,1}(j)$.

[5] $$p_{ni,1}(j) = \left(\frac{c_{i,1}}{z_{i,1}(j)}\right) d_{ni}$$

After shopping around for the best deal to purchase good j, buyers in destination economy n eventually pay the lowest price out of all the prices posted by the source economies at time t =1.

[6] $$p_{n,1}(j) = \min\{p_{ni,1}(j); i = 1, \dots, N\}$$

5.3 Technology and Heterogeneity Determine Efficiency and the Prices of Traded Goods

For an economy i at time t, the efficiency of producing good j is the draw (independent for each j) of a random variable from probability distribution $F_{i,t}(z) = \Pr[Z_{i,t} \leq z]$. Given the economy's time-invariant state of technology $T_i > 0$ (reflecting its absolute advantage), and the economy-time-invariant prevalence of comparative advantage in global trade $\theta > 0$; EK assume an extreme-value Fréchet distribution for efficiency in the economy.

[7] $$F_{i,t}(z) = e^{-T_i z^{-\theta}}$$

Here, a larger T_i represents a greater probability of an elevated level of efficiency; while a larger θ represents less variability in efficiency. Taken together, [6] and [7] imply that the menu of prices offered by economy i for export to economy n at time t = 1 can be drawn from the following distribution.

[8] $$G_{ni,1}(p) = 1 - F_{i,1}(c_{i,1} d_{ni}/p) = 1 - e^{-\left[T_i (c_{i,1} d_{ni})^{-\theta}\right] p^{\theta}}$$

Given that buyers in destination economy n eventually pay the lowest price out of all the prices posted by the source economies, the distribution of prices of goods traded in economy n at time t =1 is $G_{n,1}(p)$ and shares the form of $G_{ni,1}(p)$.

[28] Note that $d_{ii} = 1$; and for any three economies i, n, and k, $d_{ni} \leq d_{nk} d_{ki}$ (i.e., the triangle inequality of cross-border arbitrage).

[9] $$G_{n,1}(p) = 1 - e^{-\Phi_n p^\theta}, \text{ where } \Phi_{n,1} = \sum_{i=1}^{N} T_i\left(c_{i,1} d_{ni}\right)^{-\theta}$$

5.4 Trade Shares, Export Concentration, and Exchange Rates

Following Dumas (1992) and Hollifield and Uppal (1997), this paper defines the bilateral exchange rate as the relative price levels between two economies.[29] Among the useful features of the price distributions $G_{n,1}(p)$, two are important for understanding the relation between trade shares and exchange rates.

The first useful feature is that given the overall price distribution in destination economy n at time t = 1, conditioning on the source has no bearing on the price of purchased goods.[30] The second useful feature is that economy i's share of exports to economy n at time t = 1, $X_{ni,1}/X_{n,1}$, is equal to the probability that economy i sells a good j to economy n at time t = 1, $\pi_{ni,1}$.

[10] $$\pi_{ni,1} = \frac{T_i\left(c_{i,1} d_{ni}\right)^{-\theta}}{\Phi_{n,1}} = \frac{X_{ni,1}}{X_{n,1}}$$

Here at time t = 1; $X_{n,1}$ is the total spending in economy n, with $X_{ni,1}$ being spent on goods imported from economy i, and $X_{nn,1}$ being spent on goods produced in domestically in economy n. $\pi_{ni,1}$ is a measure of export diversification in that a larger $\pi_{ni,1}$ corresponds to economy i exporting a wider range of goods to economy n at time t = 1.

The model also presents an important relation between trade flows and the exchange rate.

[11] $$\frac{X_{ni,1}/X_{n,1}}{X_{ii,1}/X_{i,1}} = \left(\frac{p_{i,1} d_{ni}}{p_{n,1}}\right)^{-\theta}$$

At time t = 1; the ratio of economy i's share of exports in economy n to economy i's share of sales in its domestic market, is positively related to the value of economy i's currency in terms of

29 The definition of relative price levels as the exchange rate is commonplace in studies of purchasing power parity (PPP).

30 EK write that a "source with a higher state of technology, lower input cost, or lower barriers exploits its advantage by selling a wider range of goods, exactly to the point (or cutoff) at which the distribution of prices for what it sells in n is the same as n's overall price distribution."

economy n's currency, $p_{n,1}/p_{i,1}$.

5.5 Trade Shocks, Contract Frictions, and Expected Currency Returns

By summarizing the core elements of the EK model, Sections 5.2 to 5.4 describe the relation between trade shares and exchange rates in Period 1. To study expected currency returns in this paper's model, it is necessary to characterize the way in which investors expect trade shares and exchanges rates to evolve in Period 2. Contracts are written based on trade shares $X_{ni,1}/X_{n,1}$ and are expected to be met by firms in the second period. The contracts specify the goods that are expected to be delivered. However, in the second period, firms experience stochastic shocks to input costs (i.e., trade shocks).

5.5.1. *Transforming Trade Flows*

To study the role of trade shocks in the second period, it is useful to invoke a transformation to the functional form for trade shares that preserves the economic relation between input costs and trade flows.

[12] $$\frac{X_{ni,t}}{X_{n,t}} = \pi_{ni,t} = f\left(\Phi_{n,t}, c_{i,t}; d_{ni}, T_i, \theta\right), \text{ where } f'\left(c_{i,t}\right) < 0$$

A negative log transformation is a natural candidate that facilitates an extreme-value distribution for trade shares. Under the transformation, [10] becomes [12] with cost index $B_{ni,1}$.

[13] $$\pi_{ni,1} = k_{ni,1}\left[-\log B_{ni,1}\right]^{-1/\theta}, \text{ where } k_{ni,1} = \frac{T_i}{\Phi_{n,1}}; B_{ni,1} = 1/e^{c_{i,1}d_{ni}{}^{\theta^2}}$$

At time $t = 1$; $\tilde{\pi}_{ni,2}$ is a random variable given that stochastic cost shocks are yet to be realized. These cost shocks $\tilde{\xi}_{i,2}$ are uniformly distributed; $\tilde{\xi}_{i,2} \sim U\left(0, B_{ni,1}^{-1}\right)$.

[14] $$\tilde{\pi}_{ni,2} = \tilde{k}_{ni,2}\left[-\log \tilde{B}_{ni,2}\right]^{-1/\theta}, \text{ where } \tilde{B}_{ni,2} = \tilde{\xi}_{i,2} B_{ni,1}; \tilde{B}_{ni,2} \sim U(0,1)$$

Here, $\tilde{\pi}_{ni,2}$ follows an extreme-value Fréchet distribution, and $\tilde{\pi}_{ni,2}^{-1}$ follows an extreme-value

Weibull distribution.[31]

[15] $$\tilde{\pi}_{ni,2} \sim \text{Fréchet}\left(\theta, \tilde{k}_{ni,2}\right);\ \tilde{\pi}_{ni,2}^{-1} \sim \text{Weibull}\left(\theta, \tilde{k}_{ni,2}^{-1}\right)$$

5.5.2. *The Contract Differential and the Exchange Rate*

Given that export contracts are fixed, the realized currency return in the second period is a function of the trade shares in the first period, $\pi_{ni,1}$, and the realized export capacity in the second period, $\pi_{ni,2}$.

[16] shows that the exchange rate $s_{ni,t}$ can be represented as a function of trade flows.

[16] $$s_{ni,t}^{\theta} = d_{ni}^{\theta} \frac{\pi_{ni,t}}{\pi_{ii,t}}$$

Assuming that domestic contracts are always filled, the difference in exchange rates between the two periods is a function of the difference in trade shares.

[17] $$s_{ni,2}^{\theta} - s_{ni,1}^{\theta} = Q\left(\pi_{ni,2} - \pi_{ni,1}\right), \text{ where } Q = \frac{d_{ni}^{\theta}}{\pi_{ii}}; \pi_{ii} = \pi_{ii,1} = \pi_{ii,2}$$

5.5.3. *Export Concentration and Expected Currency Returns*

In the presence of trade shocks; firms will either meet or fall short of contract terms, and trade shares are expected to fall on average. Moreover, the difference in trade shares in [17] is either negative or zero representing an "option-like" payoff. At time t = 1; the expected difference in the exchange rate is a function of a real option on Period 2 trade shares with a "strike" in Period 1 trade shares.

[18] $$E_{t=1}\left[\, s_{ni,1}^{\theta} - \tilde{s}_{ni,2}^{\theta}\, \right] = E_{t=1}\left[Q\left(\pi_{ni,1} - \tilde{\pi}_{ni,2}\right)\right]; P_2 = \left(\pi_{ni,1} - \pi_{ni,2}\right)^{+}$$

[19] $$E_{t=1}\left[\, \tilde{s}_{in,2}^{\theta} - s_{in,1}^{\theta}\right] = E_{t=1}\left[Q^{-1}\left(\tilde{\pi}_{ni,2}^{-1} - \pi_{ni,1}^{-1}\right)\right]; C_2 = \left(\pi_{ni,2}^{-1} - \pi_{ni,1}^{-1}\right)^{+}$$

[18] is a put option with a $\pi_{ni,1}$ strike, while [19] is a call option with a $\pi_{ni,1}^{-1}$ strike. If C_1 is the

[31] An asymmetric distribution of trade shares also emerges from uniform cost shocks $U(0.75{,}1.25)$ to the original functional form in [10]. However, this paper's extreme-value trade share distribution is more flexible, and more economically consistent with the original EK model.

value of the call option at time t = 1, then the expected return of economy n's currency in terms of economy i's currency is as follows.

[20] $$\theta \log E_1[R_{in}] = \log(Q^{-1}C_1)$$

$$E_1[R_{in}] = (Q^{-1}C_1)^{\frac{1}{\theta}}$$

If $\tilde{\pi}_{ni,2}^{-1}$ follows an extreme-value Weibull distribution, then C_1 can be calculated using an option pricing formula for a Weibull distribution.[32]

[21] $$C_1 = S_1 e^{-r_n}\left[1 - H_{2\left(1+{}^{1}/_{\theta}\right)}(2\omega)\right] - \pi_{ni,1}^{-1} e^{-r_i} e^{-\omega}$$

$$\omega = \bar{k}_{ni,2}^{\theta}\left(\pi_{ni,1}^{-1}\right)^{\theta} e^{-\theta(r_i - r_n)}$$

$$\bar{k}_{ni,2} = E_1\left[\tilde{k}_{ni,2}\right]$$

Here, r_n and r_i are the risk-free rates in economy n and economy i; while H_b is a χ_2 distribution with b degrees of freedom. $\bar{k}_{ni,2}$ is the expected value of $T_i/\widetilde{\Phi}_{n,2}$ under the assumption of a truncated cost index, $\tilde{B}_{ni,2}$.[33] S_1 is the "spot rate" for the option.[34]

Given that trade shares represent export diversification, and inverse trade shares represent export concentration, expected currency returns $E_1[R_{in}]$ are related to export concentration through the strike $\pi_{ni,1}^{-1}$.[35] The relation can be characterized by the first derivative of $C_1$with respect to the strike.

[22] $$\frac{dC_1}{d\pi_{ni,1}^{-1}} = \omega'\left(\pi_{ni,1}^{-1}\right)\left[\pi_{ni,1}^{-1} e^{-r_i} e^{-\omega} - S_1 e^{-r_n} h_{2\left(1+{}^{1}/_{\theta}\right)}(2\omega)\right] - e^{-r_i} e^{-\omega}$$

---

[32] Savickas (2002) assumes a Weibull distribution to present an option pricing model that allows for the estimation of the underlying parameters. This paper uses a similar model with real trade shares that represent exchange rates in a "currency option" framework. Exports from economy n to economy i correspond the value of economy n's currency in terms of economy i's currency. These trade flows are therefore discounted by the relevant interest rates.

[33] $E_1\left[\widetilde{\Phi}_{n,2}\right] = T_i\left[-\log B_{ii,1}\right]^{-1/\theta} + \sum_{i\neq n}^{N} T_i\left[-\log\{0.5B_{ni,1} + \left(1 - B_{ni,1}\right)\}\right]^{-1/\theta}$.

[34] The assumed spot rate does not play a crucial role in this paper's propositions. However, a reasonable spot could be the expected value of the trade share under $\bar{k}_{ni,2}$, $E_1\left[\tilde{\pi}_{ni,2}^{-1}\right] = \bar{k}_{ni,2}^{-1}\Gamma\left(1 + \frac{1}{\theta}\right)$; or an "at-the-money" spot.

[35] The exogenous variation in $\pi_{ni,1}^{-1}$ can be assumed to be driven by $c_{i,1}$, which will have only a marginal influence on $E_1\left[\widetilde{\Phi}_{n,2}\right]$.

A negative sign for the first derivative in [22] corresponds to a positive relation between economy i's export concentration and its expected currency return. Proposition 1 states that in the presence of sufficiently high production costs, there is a positive relation between export concentration and expected currency returns. The proposition implies that export risk plays a stronger role in expected currency returns when production costs are higher, and cost shocks are more impactful.

Proposition 1 (Trade Costs and the Relation between Export Concentration and Expected Currency Returns): In an environment where input costs $c_{i,t}$ are sufficiently high, there is a positive relation between export concentration and expected currency returns.

Proof of Proposition 1

See Appendix B ■

6. Conclusion

Covid-19, a pandemic whose speed and severity rivaled those of the 1918 influenza epidemic, has caused untold suffering and death. Covid-19 has also had detrimental effects on the global economy by presenting a large trade shock to both supply and demand (Ornelas, Liu, and Shi, 2021). One important consequence of the pandemic is that it has motivated government leaders to enhance trade resilience, defined as the inherent ability and adaptive responses which enable economies to avoid potential losses from trade shocks (Mena, Karatzas, and Hansen, 2022).

The link between trade shocks and exchange rate changes has been well documented (Mendoza, 1995; Schmitt-Grohé and Uribe, 2018). Nevertheless, by exploring the idea of export risk, I show that investors are willing to pay a premium for the currencies of economies that exhibit greater trade resilience (i.e., less export risk).

To capture export risk, I use two measures derived from product-level international trade data: export quality and export concentration. For each economy, export quality is defined as the export price that is unexplained by production costs, distance, or exporter income per capita (Henn et al., 2020); while export concentration is a commonly used Theil measure of diversification (Papageorgiou, Spatafora, and Wang; 2015). These measures are motivated by the results that come out of the literature on international trade. Economies with stronger export quality are also more resilient to trade shocks (Brambilla, Lederman, and Porto, 2012); while export concentration is positively related to economic volatility (Mobarak, 2005). Like earlier studies, this paper finds that export concentration is positively related to economic volatility. This paper also shows that export quality is negatively related to economic volatility.[36]

To determine whether an economy's export risk is unrelated to its excess currency returns in a standard factor model of asset pricing; this paper studies a sample of 53 economies for the months October 1983 to December 2015, while employing cross-sectional empirical methods with a currency portfolio approach.

Consistent with the idea that economies with stronger export concentration exhibit greater returns, the average excess currency return increases with a portfolio's average export concentration, mainly through the extensive margin. Consistent with the idea that economies with weaker export quality exhibit greater returns, the average excess currency return decreases with a portfolio's average export quality. When combining the two measures to construct export risk as a quality-adjusted measure of export concentration (export concentration extensive divided by export quality); I show that the average excess currency return increases with a

[36] See Appendix B.

portfolio's average export risk. These findings are robust when limiting the sample to higher-income economies; and when sorting on exposures rather than measures.

This paper shows that export risk is largely recognized in the forward discount component of average excess returns. Therefore, economies with greater export risk, also exhibit higher interest rates; and the positive relation between the average forward discount and future monthly currency returns, may in part occur because of export risk. These findings are consistent with a Ricardian trade model, which shows that when input costs are sufficiently high, there is a positive relation between export risk and expected currency returns.

Although the existing literature shows that excess currency returns are influenced by international trade and finance (Della Corte, Riddiough, and Sarno, 2016; Barrot, Loualiche, and Sauvagnat. 2019); this paper is the first to document the link between export risk and excess currency returns.

What is one possible economic mechanism behind this paper's main empirical findings? I present evidence which suggests that one fundamental economic risk associated with exporting is that trade flows fall short of expectations.[37] The US is the largest importer in the world; and as the US dollar appreciates, Americans buy more exports, thereby increasing the returns of risky-exporter currencies relative to others. Unlike other popular currency factors (CENT, SIZE, IMR, CAR, DOL, IMB), the export risk factor (TRAD) exhibits *greater* excess returns as the US dollar appreciates.

Upon investigating the pricing performance of the export risk factor, I find that a two-factor pricing model (DOL + TRAD) does very well in explaining the cross-section of currency portfolio returns; and the pricing kernel is consistently characterized under all three weighting matrices (identity, Hansen-Jagannathan, and optimal).

[37] See fn. 12.

Taken together, my findings suggest that an economy's resilience to trade shocks is important for its excess currency returns in the cross-section. Therefore, a policy of export diversification may not only improve the economy's welfare (Atkin and Donaldson, 2021); the policy may induce investors to pay more for the economy's currency.[38] Although this paper's evidence is consistent with the idea that trade shocks are driven by trade-partner expenditure, trade shocks might also arise from other sources.[39] Future research that explores the heterogeneity of trade shocks, may prove useful.

[38] In Appendix B, I present a case study of Singapore. From 1985 to 1995, Singapore pursued an economic policy of export diversification (i.e., going from a risky currency portfolio to a safe currency portfolio), while experiencing concurrent currency appreciation.

[39] See fn. 1.

References

Amin Gutiérrez de Piñeres, Sheila, and Michael Ferrantino. 1997. Export Diversification and Structural Dynamics in the Growth Process: The Case of Chile. Journal of Development Economics 52, 375-391.

Atkin, David, and Dave Donaldson. 2021. The Role of Trade in Economic Development. Unpublished working paper.

Barrot, Jean Noël, Erik Loualiche, and Julien Sauvagnat. 2019. The Globalization Risk Premium. Journal of Finance 74, 2391-2439.

Bems, Rudolfs, Robert C. Johnson, and Kei-Mu Yi. 2013. The Great Trade Collapse. Annual Review of Economics 5, 375-400.

Brambilla, Irene, Daniel Lederman, and Guido Porto. 2012. Exports, Export Destinations, and Skills. American Economic Review 102, 3406-3438.

Carlton, Dennis W. 1979. Contracts, Price Rigidity, and Market Equilibrium. Journal of Political Economy 87, 1034-1062.

Choi, Yo Chul, David Hummels, and Chong Xiang. 2009. Explaining Import Quality: The Role of the Income Distribution. Journal of International Economics 77, 265-275.

Colacito, Riccardo, Steven J. Riddiough, and Lucio Sarno. 2020. Business Cycles and Currency Returns. Journal of Financial Economics 137, 659-678.

Costinot, Arnaud, and Dave Donaldson. 2012. Ricardo's Theory of Comparative Advantage: Old Idea, New Evidence. American Economic Review 102, 453-458.

Costinot, Arnaud, Dave Donaldson, and Ivana Komunjer. 2012. What Goods Do Countries Trade? A Quantitative Exploration of Ricardo's Ideas. Review of Economic Studies 79, 581-608.

Cuberes, David, and Michał Jerzmanowski. 2009. Democracy, Diversification and Growth Reversals. Economic Journal 119, 1270-1302.

Della Corte, Pasquale, Steven J. Riddiough, and Lucio Sarno. 2016. Currency Premia and Global Imbalances. Review of Financial Studies 29, 2161-2193.

di Giovanni, Julian, and Andrei A. Levchenko. 2009. Trade Openness and Volatility. Review of Economics and Statistics 91, 558-585.

di Giovanni, Julian, and Andrei A. Levchenko. 2012. The Risk Content of Exports: A Portfolio View of International Trade. In: Frankel, Jeffrey A.; Christopher A. Pissarides (Eds.). *NBER International Seminar on Macroeconomics 8*, University of Chicago Press, Chicago, IL, 97-151.

Fama, Eugene F. 1984. Forward and Spot Exchange Rates. Journal of Monetary Economics 14, 319-338.

Fama, Eugene F., and James D. MacBeth. 1973. Risk, Return, and Equilibrium: Empirical Tests. Journal of Political Economy 81, 607-636.

Gopinath, Gita, Emine Boz, Camila Casas, Federico J. Díez, Pierre-Olivier Gourinchas, and Mikkel Plagborg-Møller. 2020. Dominant Currency Paradigm. American Economic Review 110, 677-719.

Greenland, Andrew, Mihai Ion, John Lopresti, and Peter Schott. 2020. Using Equity Market Reactions to Infer Exposure to Trade Liberalization. Unpublished working paper.

Hallak, Juan Carlos. 2006. Product Quality and the Direction of Trade. Journal of international Economics 68, 238-265.

Hansen, Lars P. 1982. Large Sample Properties of Generalized Method of Moments Estimators. Econometrica 50, 1029-1054.

Hansen, Lars P., and Robert J. Hodrick. 1980. Forward Exchange Rates as Optimal Predictors of Future Spot Rates: An Econometric Analysis. Journal of Political Economy 88, 829-853.

Hansen, Lars P., and Ravi Jagannathan. 1997. Assessing Specification Errors in Stochastic Discount Factor Models. Journal of Finance 52, 557-90.

Hart, Danielle K. 2022. If Past is Prologue, then the Future is Bleak: Contracts, Covid–19, and the Changed Circumstances Doctrines. Texas A&M Law Review 9, 347-403.

Hassan, Ramin, Erik Loualiche, Alexandre R. Pecora, and Colin Ward. 2021. International Trade and the Risk in Bilateral Exchange Rates. Unpublished working paper.

Hassan, Tarek A. 2013. Country Size, Currency Unions, and International Asset Returns. Journal of Finance 68, 2269-2308.

Henn, Christian, Chris Papageorgiou, Jose Manuel Romero, and Nikola Spatafora. 2020. Export Quality in Advanced and Developing Economies: Evidence from a New Data Set. IMF Economic Review 68, 421-451.

Hesse, Heiko. 2009. Export Diversification and Economic Growth. In: Newfarmer, Richard; William Shaw, Peter Walkenhorst (Eds.). *Breaking Into New Markets: Emerging Lessons for Export Diversification*. World Bank Publications.

Hodrick, Robert J., and Xiaoyan Zhang. 2001 Evaluating the Specification Errors of Asset Pricing Models. Journal of Financial Economics 62, 327-376.

Hollifield, Burton, and Raman Uppal. 1997. An Examination of Uncovered Interest Rate Parity in Segmented International Commodity Markets. Journal of Finance 52, 2145-2170.

Hummels, David, and Peter J. Klenow. 2005. The Variety and Quality of a Nation's Exports. American Economic Review 95, 704-723.

Hummels, David, and Alexandre Skiba. 2004. Shipping the Good Apples Out? An Empirical Confirmation of the Alchian-Allen Conjecture. Journal of Political Economy 112, 1384-1402.

Ilzetzki, Ethan, Carmen M. Reinhart, and Kenneth S. Rogoff. 2019. Exchange Arrangements Entering the Twenty-First Century: Which Anchor will Hold? Quarterly Journal of Economics 134, 599-646.

Imbs, Jean, and Romain Wacziarg. 2003. Stages of Diversification. American Economic Review 93, 63-86.

Jagannathan, Ravi, and Zhenyu Wang. 1996. The Conditional CAPM and the Cross-Section of Expected Returns. Journal of Finance 51, 3-53.

Jenkins, Sarah Howard. 1998. Exemption for Nonperformance: UCC, CISG, UNIDROIT Principles--A Comparative Assessment. Tul. L. Rev. 72, 2015.

Juvenal, Luciana, and Ivan Petrella. 2020. Terms-of-Trade Shocks are Not all Alike. Unpublished working paper.

Kalemli-Ozcan, Sebnem, Elias Papaioannou, and Fabrizio Perri. 2013. Global Banks and Crisis Transmission. Journal of International Economics 89, 495-510.

Kalemli-Ozcan, Sebnem, Elias Papaioannou, and Jose-Luis Peydro. 2013. Financial Regulation, Financial Globalization, and the Synchronization of Economic Activity. Journal of Finance 68, 1179-1228.

Koren, Miklós, and Silvana Tenreyro. 2007. Volatility and Development. Quarterly Journal of Economics 122, 243-287.

Kuruvilla, Sarosh. 1996. Linkages between Industrialization Strategies and Industrial Relations/Human Resource Policies: Singapore, Malaysia, the Philippines, and India. Industrial and Labor Relations Review 49, 635-657.

Kydland, Finn E., and Edward C. Prescott. 1982. Time to Build and Aggregate Fluctuations. Econometrica 50, 1345-1370.

Lane, Philip R., and Gian Maria Milesi-Ferretti. 2007. The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970–2004. Journal of International Economics 73, 223-250.

Lee, Wanki. 1990. Exemptions of Contract Liability Under the 1980 United Nations Convention. Penn State International Law Review 8, 375-394.

Lustig, Hanno, and Adrien Verdelhan. 2007. The Cross Section of Foreign Currency Risk Premia and Consumption Growth Risk. American Economic Review 97, 89-117.

Lustig, Hanno, Nikolai Roussanov, and Adrien Verdelhan. 2011. Common Risk Factors in Currency Markets. Review of Financial Studies 24, 3731-3777.

Mau, Karsten. 2016. Export Diversification and Income Differences Reconsidered: The Extensive Product Margin in Theory and Application. Review of World Economics 152, 351-381.

Meier, Matthias, and Eugenio Pinto. 2020. Covid-19 Supply Chain Disruptions. Covid Economics 48, 139-170.

Melitz, Marc J. 2003. The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. Econometrica 71, 1695-1725.

Mena, Carlos, Antonios Karatzas, and Carsten Hansen. 2022. International Trade Resilience and the Covid-19 Pandemic. Journal of Business Research 138, 77-91.

Mendoza, Enrique G. 1995. The Terms of Trade, the Real Exchange Rate, and Economic Fluctuations. International Economic Review 36, 101-137.

Menkhoff, Lukas, Lucio Sarno, Maik Schmeling, and Andreas Schrimpf. 2012. Carry Trades and Global Foreign Exchange Volatility. Journal of Finance 67, 681-718.

Mobarak, Ahmed Mushfiq. 2005. Democracy, Volatility, and Economic Development. Review of Economics and Statistics 87, 348-361.

Ornelas, Emanuel, Xuepeng Liu, and Huimin Shi. 2021. The Trade Impact of the Covid-19 Pandemic. Unpublished working paper.

Papageorgiou, Chris, Nikola Spatafora, and Ke Wang. 2015. Diversification, Growth, and Volatility in Asia. Unpublished working paper.

Rapsomanikis, Michael G. 1980. Frustration of Contract in International Trade Law and Comparative Law. Duq. L. Rev. 18, 551.

Ready, Robert, Nikolai Roussanov, and Colin Ward. 2017. Commodity Trade and the Carry Trade: A Tale of Two Countries. Journal of Finance 72, 2629-2684.

Richmond, Robert J. 2019. Trade Network Centrality and Currency Risk Premia. Journal of Finance 74, 1315-1361.

Rodan, Garry. 2016. *The Political Economy of Singapore's Industrialization: National State and International Capital*.

Ross, Michael L. 2015. What Have We Learned about the Resource Curse? Annual Review of Political Science 18, 239-259.

Ross, Stephen A. 1976. The Arbitrage Theory of Capital Asset Pricing. Journal of Economic Theory 13, 341-360.

Salih, Kamal, Mei Ling Young, and Rajah Rasiah. 1988. *Transnational Capital and Local Conjuncture: The Semiconductor Industry in Penang*. Malaysian Institute of Economic Research.

Schmitt-Grohé, Stephanie, and Martín Uribe. 2018. How Important are Terms-Of-Trade Shocks? International Economic Review 59, 85-111.

Schott, Peter K. 2004. Across-Product Versus Within-Product Specialization in International Trade. Quarterly Journal of Economics 119, 647-678.

Verdelhan, Adrien. 2018. The Share of Systematic Variation in Bilateral Exchange Rates. Journal of Finance 73, 375-418.

Verhoogen, Eric A. 2008. Trade, Quality Upgrading, and Wage Inequality in the Mexican Manufacturing Sector. Quarterly Journal of Economics 123, 489-530.

Verhoogen, Eric. 2020. Firm-Level Upgrading in Developing Countries. Unpublished working paper.

Yue, Kan. 2021. Estimating Exporter's Quality: Do Importers Agree on Rankings? The World Economy 44, 462-484.

Zarnowitz, Victor. 1962. Unfilled Orders, Price Changes, and Business Fluctuations. Review of Economics and Statistics 44, 367-394.

Table 1. Summary Statistics

This table presents the summary statistics for the economy-month observations. The sample period is October 1983 to December 2015. *Excess return* is the monthly return to buying a foreign currency in the forward market (at the forward rate) at time *t* and then selling it in the spot market (at the spot rate) at time *t* + 1. *Forward discount* is the discount of the forward rate to the spot rate at time *t* (expressed as a percentage of the forward rate). *Spot return* is the monthly return to buying a foreign currency in the spot market at time *t* and then selling it in the spot market at time *t* + 1 (expressed as a percentage of the forward rate). *Export quality* is a measure of export quality, defined as the export price that is unexplained by production costs, distance, or exporter income per capita. *Export concentration intensive* is a within-Theil (intensive) measure of export concentration referring to the concentration of export volumes within product categories. *Export concentration extensive* is a between-Theil (extensive) measure of export concentration reflecting the concentration of export volumes in fewer product categories. *Export concentration total* is an overall Theil measure of export concentration; and is the sum of the intensive and extensive components. *Export risk* is *Export concentration extensive* divided by *Export quality*. *Output volatility* is the sample period standard deviation for the growth of real gross domestic product (GDP) per capita in the economy. *Volatility change* (VIX) is the monthly change in the VIX index. *Volatility change* (VXY) is the monthly change in JP Morgan's VXY index.

Variable Name	Mean	sd.	Q50	Obs.
Excess return	0.265	3.625	0.202	10709
Forward discount	0.272	1.198	0.126	10634
Spot return	-0.045	3.255	0.032	10675
Export quality	0.944	0.079	0.964	9887
Export concentration total	2.232	0.727	2.099	10037
Export concentration intensive	2.076	0.673	1.960	10037
Export concentration extensive	0.155	0.160	0.094	10037

Table 2. Export Risk and Currency Returns: Portfolios

This table presents the average excess returns of export currency portfolios at time *t*, sorted on economy variables at time *t* – 1 in Panels A and C; along with various summary statistics for the export currency hedge portfolios in Panels B and D. Excess returns are expressed in percentage per annum. Newey and West (1987) standard errors with optimal lag selection, are reported in parentheses. The sample period is October 1983 to December 2015. The variable and estimate definitions [descriptions] are presented in Table 1 [Table A.1].

Panel A: All Economies

Portfolio	Q1	Q2	Q3	Q4	Q5	Q5 – Q1
Export concentration total	2.635	3.107	2.773	2.451	3.606	0.970
	(0.551)	(0.506)	(0.495)	(0.461)	(0.700)	(0.561)
Export concentration intensive	3.063	2.942	2.906	2.856	2.206	-0.858
	(0.551)	(0.506)	(0.471)	(0.395)	(0.804)	(0.658)
Export concentration extensive	1.987	1.818	2.945	2.602	5.609	3.622
	(0.488)	(0.506)	(0.495)	(0.471)	(0.651)	(0.565)
Export quality	0.458	1.997	4.010	4.014	4.024	3.566
	(0.461)	(0.495)	(0.561)	(0.443)	(0.731)	(0.658)
Export risk	2.012	1.393	3.293	2.258	5.962	3.950
	(0.485)	(0.530)	(0.516)	(0.471)	(0.630)	(0.554)

Panel B: All Economies

Q5 – Q1 Portfolio	Export concentration total	Export concentration intensive	Export concentration extensive	Export quality	Export risk
Mean (annualized)	0.970	-0.858	3.622	3.566	3.950
Standard deviation (annualized)	7.867	8.350	7.913	8.163	7.948
Autocorrelation (1)	0.147	0.031	0.091	0.140	0.113
Skewness	0.628	0.031	0.865	0.451	0.888
Kurtosis	6.478	8.937	8.802	5.990	8.694
Reward-risk ratio (Sharpe, annualized)	0.123	-0.103	0.458	0.437	0.497

Panel C: Higher-Income Economies

Portfolio	Q1	Q2	Q3	Q4	Q5	Q5 – Q1
Export concentration total	1.901	1.773	2.456	2.624	1.398	0.502
	(0.572)	(0.592)	(0.561)	(0.620)	(0.599)	(0.329)
Export concentration intensive	2.959	2.179	2.465	0.948	1.689	-1.270
	(0.617)	(0.613)	(0.527)	(0.530)	(0.634)	(0.391)
Export concentration extensive	1.813	2.040	0.729	2.059	5.154	3.341
	(0.582)	(0.516)	(0.568)	(0.624)	(0.679)	(0.381)
Export quality	0.947	1.918	0.982	2.307	3.842	2.895
	(0.651)	(0.592)	(0.492)	(0.579)	(0.641)	(0.627)
Export risk	2.094	1.779	0.909	1.244	5.494	3.400
	(0.565)	(0.527)	(0.603)	(0.520)	(0.700)	(0.391)

Panel D: Higher-Income Economies

Q5 – Q1 Portfolio	Export concentration total	Export concentration intensive	Export concentration extensive	Export quality	Export risk
Mean (annualized)	-0.502	-1.270	3.341	2.895	3.400
Standard deviation (annualized)	7.103	7.913	8.998	11.680	8.962
Autocorrelation (1)	0.002	0.013	-0.046	0.033	-0.043
Skewness	-0.112	-0.174	-0.352	-1.069	-0.305
Kurtosis	4.646	4.246	3.881	8.124	4.135
Reward-risk ratio (Sharpe, annualized)	-0.071	-0.160	0.371	0.248	0.379

Table 3. Export Risk and Currency Returns: Return Recognition

This table presents panel regression results for the sample where the left-hand-side (LHS) variable is *Excess return* [*Spot return*, *Forward discount*] in columns (1) and (4) [(2) and (5); (3) and (6)]. The cross-sectional method of Fama-Macbeth is applied in columns (1) to (3). A between-effects regression is applied in columns (4) to (6). The sample period is October 1983 to December 2015. The variable and estimate definitions [descriptions] are presented in Table 1 [Table A.1].

LHS Variable	**Excess Return**	**Spot Return**	**Forward Discount**	**Excess Return**	**Spot Return**	**Forward Discount**
Export quality	-0.383	3.216	-3.256	-12.456	0.276	-12.236
	(0.505)	(4.308)**	(19.365)**	(2.020)*	(0.381)	(2.098)*
Export concentration extensive	0.610	0.088	0.358	7.985	-0.301	7.875
	(2.201)*	(0.336)	(4.156)**	(2.690)**	(0.866)	(2.803)**
Method	*FMB*	*FMB*	*FMB*	*BE*	*BE*	*BE*
Model *p*-value	0.088	0.000	0.000	0.000	0.458	0.000

Absolute *t*-statistics are reported in parentheses; *p*-values are reported in brackets. Model *p*-value shows the result for a test that all of the coefficients (excluding the constant) are jointly zero. +, *, ** denote statistical significance at the 10%, 5% and 1% levels.

Table 4. Export Risk and Market Volatility

This table presents regression results for the sample where the left-hand-side (LHS) variable is the monthly excess return of the hedge portfolio (Q5 – Q1) for *Export risk*. The sample period is October 1983 to December 2015. The variable and estimate definitions [descriptions] are presented in Table 1 [Table A.1].

Volatility change (VIX)	-0.100	
	(2.821)**	
Volatility change (VXY)		-0.263
		(2.386)*
Model *p*-value	0.005	0.017

Newey and West (1987) standard errors with optimal lag selection are estimated. Absolute *t*-statistics are reported in parentheses; *p*-values are reported in brackets. Model *p*-value shows the result for a test that all of the coefficients (excluding the constant) are jointly zero. +, *, ** denote statistical significance at the 10%, 5% and 1% levels.

Table 5. Export Risk and Currency Returns: Portfolios Sorted on Betas

This table presents the average excess returns of currency portfolios at time *t*, sorted on trailing 24-month exposures (or betas) at time *t* – 1. Excess returns are expressed in percentage per annum. Newey and West (1987) standard errors with optimal lag selection, are reported in parentheses. The sample period is October 1983 to December 2015. The variable and estimate definitions [descriptions] are presented in Table 1 [Table A.1].

Portfolio	Q1	Q2	Q3	Q4	Q5	Q5 – Q1
Export concentration extensive beta	2.332	2.979	2.764	2.353	4.373	2.042
	(0.567)	(0.569)	(0.390)	(0.329)	(0.544)	(0.486)
Export quality beta	1.644	3.723	3.533	1.524	4.590	2.947
	(0.557)	(0.528)	(0.436)	(0.365)	(0.550)	(0.448)
Export risk beta	2.315	3.015	3.117	2.138	4.193	1.878
	(0.590)	(0.538)	(0.377)	(0.329)	(0.522)	(0.481)

Table 6. Export Risk and Currency Returns: Principal Components of Portfolios

This table presents the principal component coefficients of currency portfolios at time *t*, sorted on economy variables at time *t* – 1. In each panel, the last row presents the share of the total variance explained by each common factor. The sample period is October 1983 to December 2015. The variable and estimate definitions [descriptions] are presented in Table 1 [Table A.1].

Panel A: Export Risk

Export Risk Portfolio	PC1	PC2	PC3	PC4	PC5
Q1	0.491	-0.233	-0.160	-0.117	-0.815
Q2	0.487	-0.348	-0.383	0.590	0.384
Q3	0.468	-0.026	-0.132	-0.764	0.424
Q4	0.439	-0.010	0.882	0.156	0.072
Q5	0.331	0.908	-0.181	0.176	-0.050
%Var	0.776	0.114	0.061	0.028	0.022

Panel B: Export Concentration Extensive

Export Conc. X Portfolio	PC1	PC2	PC3	PC4	PC5
Q1	0.486	-0.243	-0.181	0.288	-0.768
Q2	0.472	-0.298	-0.270	0.465	0.632
Q3	0.479	-0.073	-0.291	-0.820	0.088
Q4	0.451	-0.021	0.889	-0.043	0.066
Q5	0.329	0.920	-0.138	0.161	0.010
%Var	0.780	0.109	0.060	0.031	0.021

Panel C: Export Quality

Export Quality Portfolio	PC1	PC2	PC3	PC4	PC5
Q1	0.403	-0.071	0.276	0.682	0.541
Q2	0.491	-0.197	-0.339	0.370	-0.685
Q3	0.510	-0.308	-0.477	-0.482	0.430
Q4	0.474	-0.057	0.745	-0.404	-0.231
Q5	0.334	0.926	-0.163	-0.054	0.025
%Var	0.754	0.147	0.044	0.036	0.019

Table 7. Currency Factors and US Dollar Returns

This table presents regression results for the sample where the left-hand-side (LHS) variable is the monthly excess return of the hedge portfolio (Q5 – Q1) for conditional dollar exposure (DOL) in column (1) of Panel A; global imbalances (IMB) in column (2) of Panel A; the carry trade (CAR) in column (3) of Panel A; and *Export risk* (TRAD) in column (4) of Panel A; trade centrality (CENT) in column (1) of Panel B; GDP share (SIZE) in column (2) of Panel B; import ratio (IMR) in column (3) of Panel B. The sample period is October 1983 to December 2015. The variable and estimate definitions [descriptions] are presented in Table 1 [Table A.1].

Panel A

LHS Variable	**DOL**	**IMB**	**CAR**	**TRAD**
US Dollar return	-0.790	-0.338	0.010	0.446
	(3.002)**	(3.318)**	(0.090)	(3.926)**
Model *p*-value	0.003	0.001	0.928	0.000

Newey and West (1987) standard errors with optimal lag selection are estimated. Absolute *t*-statistics are reported in parentheses; *p*-values are reported in brackets. Model *p*-value shows the result for a test that all of the coefficients (excluding the constant) are jointly zero. +, *, ** denote statistical significance at the 10%, 5% and 1% levels.

Panel B

LHS Variable	**CENT**	**SIZE**	**IMR**
US Dollar return	-0.110	0.290	0.034
	(0.667)	(1.567)	(0.184)
Model *p*-value	0.505	0.117	0.854

Newey and West (1987) standard errors with optimal lag selection are estimated. Absolute *t*-statistics are reported in parentheses; *p*-values are reported in brackets. Model *p*-value shows the result for a test that all of the coefficients (excluding the constant) are jointly zero. +, *, ** denote statistical significance at the 10%, 5% and 1% levels.

Table 8. Export Risk and Currency Returns: Factor Correlations

This table presents pairwise correlations for the monthly excess returns of the pricing factors. Hedge portfolios (Q5 – Q1) are used to create the pricing factors for *Export risk* (TRAD); trade centrality (CENT); GDP share (SIZE); import ratio (IMR); conditional dollar exposure (DOL); the carry trade (CAR); global imbalances (IMB); and momentum (MOM). The sample period is October 1983 to December 2015. The variable and estimate definitions [descriptions] are presented in Table 1 [Table A.1].

	TRAD	CENT	SIZE	IMR	DOL	CAR	IMB	MOM
TRAD	1.0000							
CENT	0.3016*	1.0000						
SIZE	0.2395*	0.5157*	1.0000					
IMR	0.1185*	0.5673*	0.4419*	1.0000				
DOL	-0.2894*	-0.0084	-0.2275*	-0.1186*	1.0000			
CAR	0.3350*	0.3383*	0.2049*	0.3941*	0.1125*	1.0000		
IMB	0.0492	0.2443*	0.2780*	-0.0011	0.1072	0.4426*	1.0000	
MOM	0.0977	-0.0011	-0.0883	-0.1774*	0.0172	0.0304	-0.0530	1.0000

* denotes statistical significance at the 5% level or smaller.

Table 9. Export Risk and Currency Returns: Pricing Tests

This table presents results from generalized method of moments (GMM) procedures for asset pricing tests with identity weights, Hansen-Jagannathan (HJ) weights, and optimal weights. The test assets include 5 carry trade portfolios, 5 momentum portfolios, 10 global imbalance portfolios (5 sorted on the net foreign asset position, and 5 on the share of foreign liabilities in domestic currency), 5 export quality portfolios, and 5 export concentration portfolios; for a total of 30 portfolios. Hedge portfolios (Q5 – Q1) are used to create the pricing factors. The set of pricing factors includes the dollar (DOL), the global imbalance (IMB), the trade centrality (CENT), the export risk (TRAD), and carry trade (CAR) factors. The sample period is December 1988 to December 2015. The variable and estimate definitions [descriptions] are presented in Table 1 [Table A.1].

	Load (DOL)	Load (FAC)	Price (DOL)	Price (FAC)	Adj R-sq	HJ
Panel A: DOL + CAR						
One-step GMM (Identity)	0.033	0.151	0.441	0.835	0.627	
	[0.562]	[0.000]**	(0.542)	(0.203)**		
One-step GMM (HJ)	0.011	0.174	0.242	0.937	0.627	0.517
	[0.732]	[0.000]**	(0.289)	(0.199)**		[0.261]
Two-step GMM (Optimal)	0.036	0.133	0.455	0.737	0.628	
	[0.132]	[0.000]**	(0.222)*	(0.122)**		
Panel B: DOL + IMB						
One-step GMM (Identity)	0.037	0.089	0.448	0.610	0.124	
	[0.366]	[0.007]**	(0.413)	(0.218)**		
One-step GMM (HJ)	0.063	0.053	0.680	0.398	0.124	0.628
	[0.017]*	[0.207]	(0.251)**	(0.263)		[0.178]
Two-step GMM (Optimal)	0.037	0.087	0.451	0.596	0.124	
	[0.006]**	[0.000]**	(0.132)**	(0.096)**		
Panel C: DOL + CENT						
One-step GMM (Identity)	0.048	0.101	0.458	0.295	-0.006	
	[0.247]	[0.203]	(0.400)	(0.234)		
One-step GMM (HJ)	0.075	0.108	0.719	0.316	-0.006	0.627
	[0.015]*	[0.029]*	(0.298)*	(0.147)*		[0.185]
Two-step GMM (Optimal)	0.067	0.093	0.640	0.270	-0.011	
	[0.015]*	[0.027]*	(0.265)*	(0.124)*		
Panel D: DOL + TRAD						
One-step GMM (Identity)	0.202	0.267	1.430	0.833	0.532	
	[0.005]**	[0.005]**	(0.525)**	(0.315)**		
One-step GMM (HJ)	0.195	0.261	1.375	0.819	0.532	0.567
	[0.000]**	[0.000]**	(0.320)**	(0.226)**		[0.359]
Two-step GMM (Optimal)	0.207	0.267	1.483	0.822	0.530	
	[0.000]**	[0.000]**	(0.154)**	(0.070)**		

Newey and West (1987) standard errors with optimal lag selection are estimated; and are reported in parentheses; *p*-values are reported in brackets. HJ denotes the Hansen and Jagannathan (1997) distance for the null hypothesis that the HJ distance is equal to zero. +, *, ** denote statistical significance at the 10%, 5% and 1% levels.

Figure 1. Test Portfolio Returns and Carry Trade Betas

This figure presents a linear regression fit and a scatter plot for the relation between average monthly test portfolio return and the average exposure (or beta) of the carry trade (CAR) pricing factor. The test assets include 5 carry trade portfolios [*fd*], 5 momentum portfolios [*mom*], 10 global imbalance portfolios (5 sorted on the net foreign asset position [*nfa*], and 5 on the share of foreign liabilities in domestic currency [*ldc*]), 5 export quality portfolios [*eq*], and 5 export concentration portfolios [*ed*]; for a total of 30 portfolios. The sample period is December 1988 to December 2015.

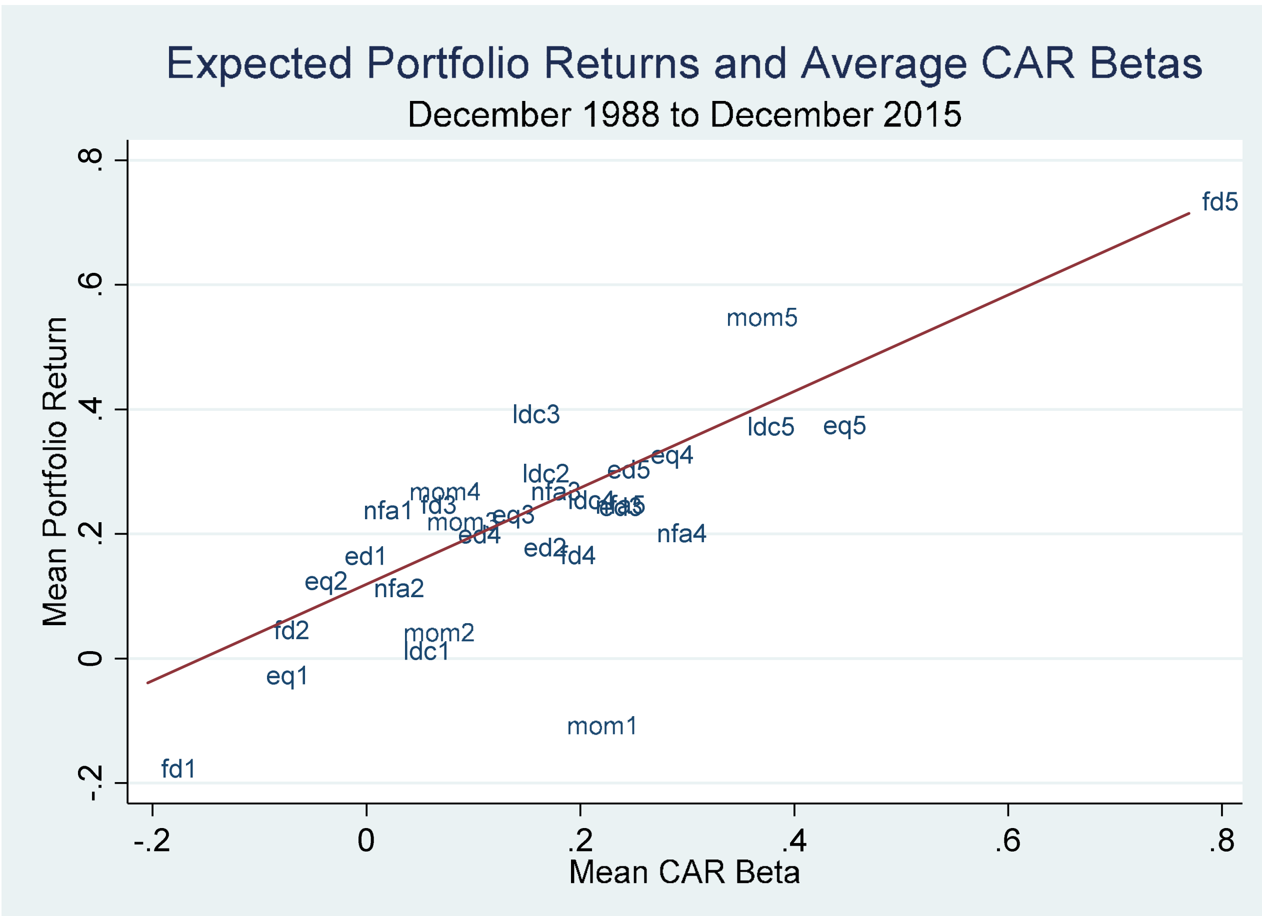
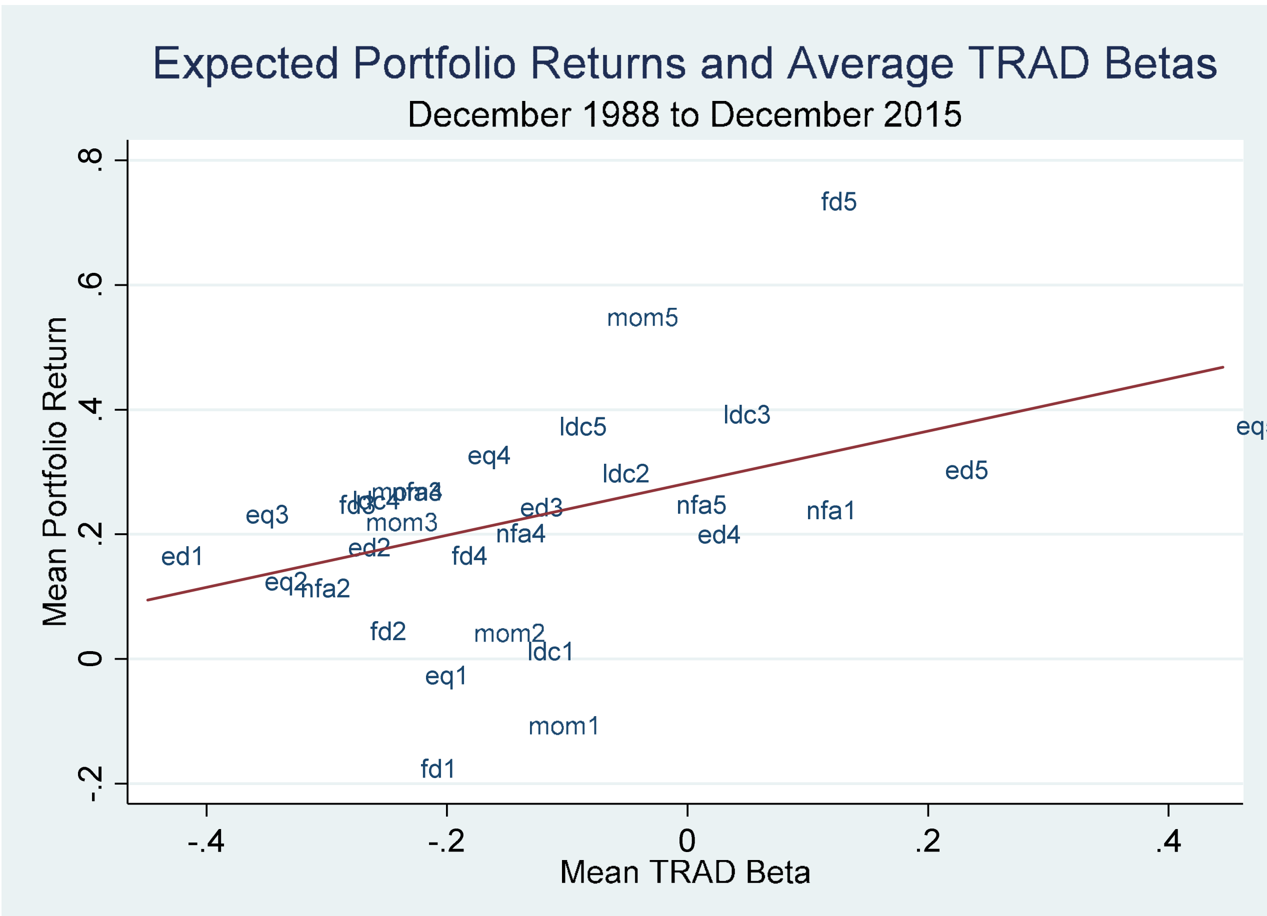


Figure 2. Test Portfolio Returns and Export Risk Betas

This figure presents a linear regression fit and a scatter plot for the relation between average monthly test portfolio return and the average exposure (or beta) of the export risk (TRAD) pricing factor. The test assets include 5 carry trade portfolios [*fd*], 5 momentum portfolios [*mom*], 10 global imbalance portfolios (5 sorted on the net foreign asset position [*nfa*], and 5 on the share of foreign liabilities in domestic currency [*ldc*]), 5 export quality portfolios [*eq*], and 5 export concentration portfolios [*ed*]; for a total of 30 portfolios. The sample period is December 1988 to December 2015.



Appendix A

A.1 Economy Sample

For a sample of economies over the months October 1983 to December 2015, this paper studies the relation between an economy's export risk and its end-of-month excess currency returns. Following Della Corte, Riddiough, and Sarno (2016), I use an initial sample of 55 currencies inclusive of the euro. Given the imprecision surrounding the estimation of export risk for euro economies, the final sample excludes the euro, and consists of 53 economies with non-missing values for the measures of export risk: Argentina, Australia, Austria, Brazil, Canada, Chile, China, Colombia, Croatia, Czech Republic, Denmark, Egypt, Estonia, Finland, France, Germany, Greece, Hong Kong, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Kazakhstan, Latvia, Lithuania, Malaysia, Mexico, Morocco, Netherlands, New Zealand, Norway, Philippines, Poland, Portugal, Russia, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, Thailand, Tunisia, Turkey, Ukraine, United Kingdom, and Venezuela. The subsample of higher-income economies is limited to Australia, Canada, Denmark, France, Germany, Italy, Japan, Netherlands, New Zealand, Norway, Sweden, Switzerland, and the United Kingdom. The variable descriptions and data sources are presented in Table A.1.

A.2 Export Risk Portfolio Economies

Table A.2 presents a list of economies, and the associated percentage of sample returns, for the Q1 and Q5 export risk portfolios. The evidence suggests that the export risk measure is novel in that it doesn't always place economies in portfolio quintiles based on the prevailing opinions on economic complexity.

Consider one example: The Russian Federation is one of the economies that consistently appears in the portfolio with the lowest risk (Q1); while Israel is one of the economies that often appears in the portfolio with the greatest risk (Q5). Based on the complexity of exports from these two economies, one might expect the Russian Federation to be characterized as the riskier economy because it exports simple products and commodities; and that Israel, with its exports of refined and complex products, would be the safer of the two economies. The data show that compared to the Russian Federation, Israel does exhibit greater export quality. However, Israel's export *concentration* in *non-traditional* products makes Israel a *riskier* exporter compared to the Russian Federation with its export diversification between traditional and non-traditional products.

Table A.2 presents additional examples which suggest that this paper's export risk measure is not merely an artifact of economy size, economic complexity, or commodity intensity.

Table A.1. Variable Descriptions and Sources

This table presents the descriptions and sources of the variables used in this paper.

Variable	Description
Excess return	The monthly return to buying a foreign currency in the forward market (at the forward rate) at time t and then selling it in the spot market (at the spot rate) at time $t + 1$. [Source: Datastream]
Forward discount	The discount of the forward rate to the spot rate at time t (expressed as a percentage of the forward rate). [Source: Datastream]
Spot return	The monthly return to buying a foreign currency in the spot market at time t and then selling it in the spot market at time $t + 1$ (expressed as a percentage of the forward rate). [Source: Datastream]
Export quality	The Henn et al. (2020) measure of export quality, defined as the export price that is unexplained by production costs, distance, or exporter income per capita. [Source: International Monetary Fund]
Export concentration intensive	A within-Theil (intensive) measure of export concentration referring to the concentration of export volumes within product categories. [Source: International Monetary Fund]
Export concentration extensive	A between-Theil (extensive) measure of export concentration reflecting the concentration of export volumes in fewer product categories. [Source: International Monetary Fund]
Export concentration total	An overall Theil measure of export concentration; and is the sum of *Export concentration intensive* and *Export concentration extensive*. [Source: International Monetary Fund]
Export risk	*Export concentration extensive* divided by *Export quality*. [Source: International Monetary Fund]
Output volatility	The sample period standard deviation for the growth of real gross domestic product (GDP) per capita in the economy. [Sources: Penn World Tables 9.1, World Bank WDI 2019]
Volatility change (VIX)	The monthly change in the VIX index. [Source: Datastream]
Volatility change (VXY)	The monthly change in JP Morgan's VXY index. [Source: Datastream]

Table A.2. Export Risk Portfolio Economies

This table presents a list of economies, and the associated percentage of sample returns, for the Q1 portfolio of *Export risk* in Panel A; and for the Q5 portfolio of *Export risk* in Panel B. The sample period is October 1983 to December 2015.

Panel A: Q1 (Least Export Risk)

Economy	**Percentage of Returns**
Slovenia	100%
France	100%
Germany	100%
Ukraine	100%
Slovak Republic	100%
Czech Republic	100%
Russian Federation	100%
Malaysia	96%
United Kingdom	90%
Croatia	83%
Lithuania	64%
Singapore	48%
Sweden	48%
Egypt, Arab Rep.	27%
Netherlands	25%
Canada	6%
Korea, Rep.	6%
Australia	3%
Denmark	3%

Panel B: Q5 (Greatest Export Risk)

Economy	**Percentage of Returns**
New Zealand	100%
Venezuela, RB	100%
Chile	100%
Philippines	100%
Greece	100%
Finland	100%
Israel	92%
Argentina	91%
Indonesia	79%
Tunisia	75%
Iceland	67%
Hong Kong, China	42%
Mexico	37%
Colombia	33%
Brazil	31%
Norway	26%
Singapore	10%
Poland	5%
Thailand	5%
Australia	3%

Appendix B

B.1 Export Risk and Output Volatility

International trade openness is linked to output volatility for an economy (di Giovanni and Levchenko, 2009); and riskier exporting industries can contribute to overall risk in an economy (di Giovanni and Levchenko, 2012). Therefore, in addition to exploring the relation between an economy's export risk and its monthly currency returns, I investigate the relation between export risk and the overall risk in an economy using this paper's measures: *Export quality* and *Export concentration total*. To test the hypothesis that export risk is unrelated to output volatility, this paper employs an economy-level cross-sectional regression.

For a cross-sectional regression which studies the relation between export risk and output volatility, consider a specification with left-hand-side (LHS) variable v_i (output volatility, or the sample-period standard deviation for economic growth). Here $i=1,\ldots,M$ is an index for economies; and ε_i is a mean zero noise term. The right-hand-side (RHS) variable, $Economy\ measure_i$; is equal to the sample-period mean of the forward discount, the sample-period mean of export quality, the sample-period mean of export concentration total, or the ratio of mean export quality to mean export concentration total (export efficiency).

[B1] $$v_i = \alpha + \delta \cdot Economy\ measure_i + \varepsilon_i$$

Table B.1 presents the results of the cross-sectional regression in [B1]. Column (1) shows a positive relation between the average forward discount and output volatility. However, the relation is strongly influenced by the outlier case of Venezuela. Column (5) shows that when Venezuela is excluded from the sample, the coefficient for the average forward discount is approximately 0.89 and is not statistically significant. Column (2) and Figure B.1 show a negative relation between the average export quality and output volatility: The coefficient is roughly -6.54 and is statistically significant at the 1% level. Column (3) shows a positive relation between the average export concentration and output volatility: The coefficient is approximately 0.58 and is statistically significant at the 10% level. Column (4) and Figure B.2 show a negative relation between export efficiency (the ratio of average export quality to average export concentration total) and output volatility: The coefficient is roughly -3.5 and is statistically significant at the 1% level. Column (6) shows that the relation is robust when excluding Venezuela.

Taken together, the findings in Table B.1, along with Figures B.1 and B.2, suggest that while the average forward discount is unrelated to output volatility; export risk is positively related to output volatility.

B.2 Currency Carry Trade Portfolio Summary Statistics

Table B.2 presents the summary statistics of currency portfolios sorted on forward discount values for all economies in Panel A, and for higher-income economies in Panel B. In each panel, the first row shows the average excess returns for the carry trade currency portfolios Q1 to Q5, in addition to the average excess returns for the Q5 – Q1 hedge portfolio (or the carry trade factor CAR). Consistent with the findings of Lustig, Roussanov, and Verdelhan (2011), Table B.2 shows that the average excess currency return increases with a portfolio's average forward discount. The annualized average excess return for the hedge portfolio is roughly 9.8% for all economies (Panel A) and 5.5% for higher-income economies only (Panel B).

B.3 A Case Study of Export Risk and Currency Returns

To characterize the relation between export risk and currency returns, this paper presents the case of Singapore, a small island nation with limited natural resources. As early as 1965, Singaporean leaders aimed to unlock the benefits of free and open trade by pursuing an export-oriented trade policy (Rodan, 2016). The export-oriented policy initially focused on attracting foreign investment in a small number of key industries (e.g., radio receivers and televisions). Figure B.3 shows that from 1965 to 1984; Singapore continued to focus on these key industries, and maintained roughly the same level of extensive export concentration. Although Singapore experienced positive annual economic growth for the entire period; Figure B.4 shows that the value of the Singapore dollar did not change much in the years leading up to 1985.

Eventually, rising wages along with intense competition from nearby "Asian Tigers," threatened Singapore's labor-intensive export-oriented strategy. To sustain higher wages, Singaporean policymakers placed less emphasis on traditional labor-intensive activities, and more emphasis on non-traditional knowledge-intensive high-technology activities. This "second industrialization phase" drove out low-cost producers in the early 1980s; and caused a recession in 1985 (Kuruvilla, 1996).[i] Figure B.3 shows that from 1985 to 1995; Singapore diversified its exports and reduced its extensive export concentration index. Figure B.4 shows that during the same period, as export concentration fell, the value of the Singapore dollar increased by roughly 50%. The finding suggests that currency traders were willing to pay higher prices—and experience lower returns—for export diversification (i.e., less export risk).

B.4. Propositions and Proofs

A negative sign for the first derivative in [22] corresponds to a positive relation between economy i's export concentration and its expected currency return. Proposition 1 states that in the presence of sufficiently high production costs, there is a positive relation between export concentration and expected currency returns. The proposition implies that export risk plays a

[i] Kuruvilla writes "By 1986, the restructuring of investment incentives and the investments made in education and skills development began to pay off. Higher-quality Japanese investments appeared, expanding the manufacturing of semiconductors, disk drives, and computer assembly. The technological depth of the foreign investments increased steadily, with many firms (for example, Motorola) locating higher-end processes and R&D services in Singapore (Salih, Young, and Rajah 1988)."

stronger role in expected currency returns when production costs are higher, and cost shocks are more impactful.

Proposition 1 (Trade Costs and the Relation between Export Concentration and Expected Currency Returns): In an environment where input costs $c_{i,t}$ are sufficiently high, there is a positive relation between export concentration and expected currency returns.

Proof of Proposition 1

Let $y = 1 + {}^{1}/_{\theta}$ and $\Lambda(\cdot) = \frac{2\omega^{y-1}}{2^{y}\Gamma(y)}$. [22] can then be shown as:

[B2] $$\frac{dC_1}{d\pi_{ni,1}^{-1}} = -e^{-\omega}\left\{\omega'\left(\pi_{ni,1}^{-1}\right)\left[S_1 e^{-r_n}\Lambda(\cdot) - \pi_{ni,1}^{-1}e^{-r_i}\right] + e^{-r_i}\right\}$$

Therefore a sufficient condition for $\frac{dC_1}{d\pi_{ni,1}^{-1}} < 0$ (i.e., a positive relation between export concentration and expected currency returns) is $S_1 e^{-r_n}\Lambda(\cdot) - \pi_{ni,1}^{-1}e^{-r_i} > 0$. The condition can be expressed as follows.

[B3] $$\bar{k}_{ni,2} S_1 \frac{2}{2^{y}\Gamma(y)} > 1$$

S_1 is an inverse share and is generally greater than 1. $\Gamma(y)$ is the gamma function and therefore the minimum value of $\frac{2}{2^{y}\Gamma(y)}$ is 0.5 for reasonable values of θ; $\theta \geq 1$. For a sufficiently high value of $\bar{k}_{ni,2}$, condition [B3] is satisfied. $\bar{k}_{ni,2}$ generally increases with input costs; and greater input costs engender a lower expected price index, $E_1\left[\widetilde{\Phi}_{n,2}\right]$ ■

Table B.1. Export Risk and Output Volatility

This table presents economy-level regression results for the sample where the left-hand-side (LHS) variable is *Output volatility*. The sample period is October 1983 to December 2015. The variable definitions [descriptions] are presented in Table 1 [Table A.1].

Forward discount (mean)	0.096				0.885	
	(7.046)**				(1.483)	
Export quality (mean)		-6.543				
		(2.722)**				
Export concentration total (mean)			0.577			
			(1.993)+			
Export quality (mean) / Export concentration total (mean)				-3.502		-3.107
				(2.728)**		(2.254)*
Venezuela included	Yes	Yes	Yes	Yes	No	No
Number of obs.	53	53	53	53	52	52
Model *p*-value	0.000	0.009	0.052	0.009	0.144	0.029

Heteroscedasticity-robust standard errors are estimated; and absolute *t*-statistics are reported in parentheses. Model *p*-value shows the result for a test that all of the coefficients (excluding the constant) are jointly zero. +, *, ** denote statistical significance at the 10%, 5% and 1% levels.

Figure B.1. Output Volatility and Average Export Quality

This figure presents a linear regression fit and a scatter plot for the relation between *Output volatility* and the sample period average of *Export quality*. The sample period is October 1983 to December 2015.

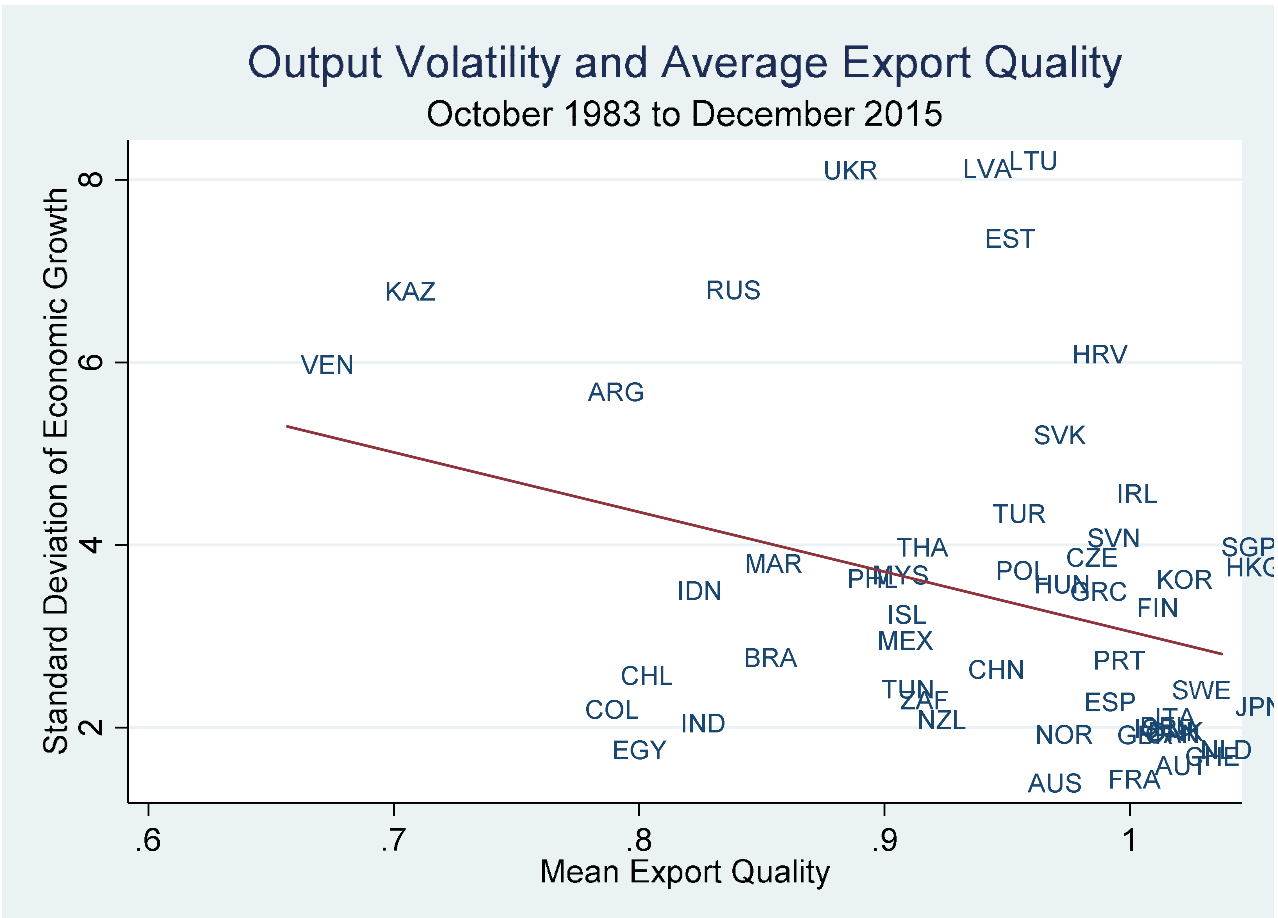


Figure B.2. Output Volatility and Export Efficiency

This figure presents a linear regression fit and a scatter plot for the relation between *Output volatility* and export efficiency. Export efficiency is the ratio of the sample period average of *Export quality* to the sample period average of *Export concentration total*. The sample period is October 1983 to December 2015.

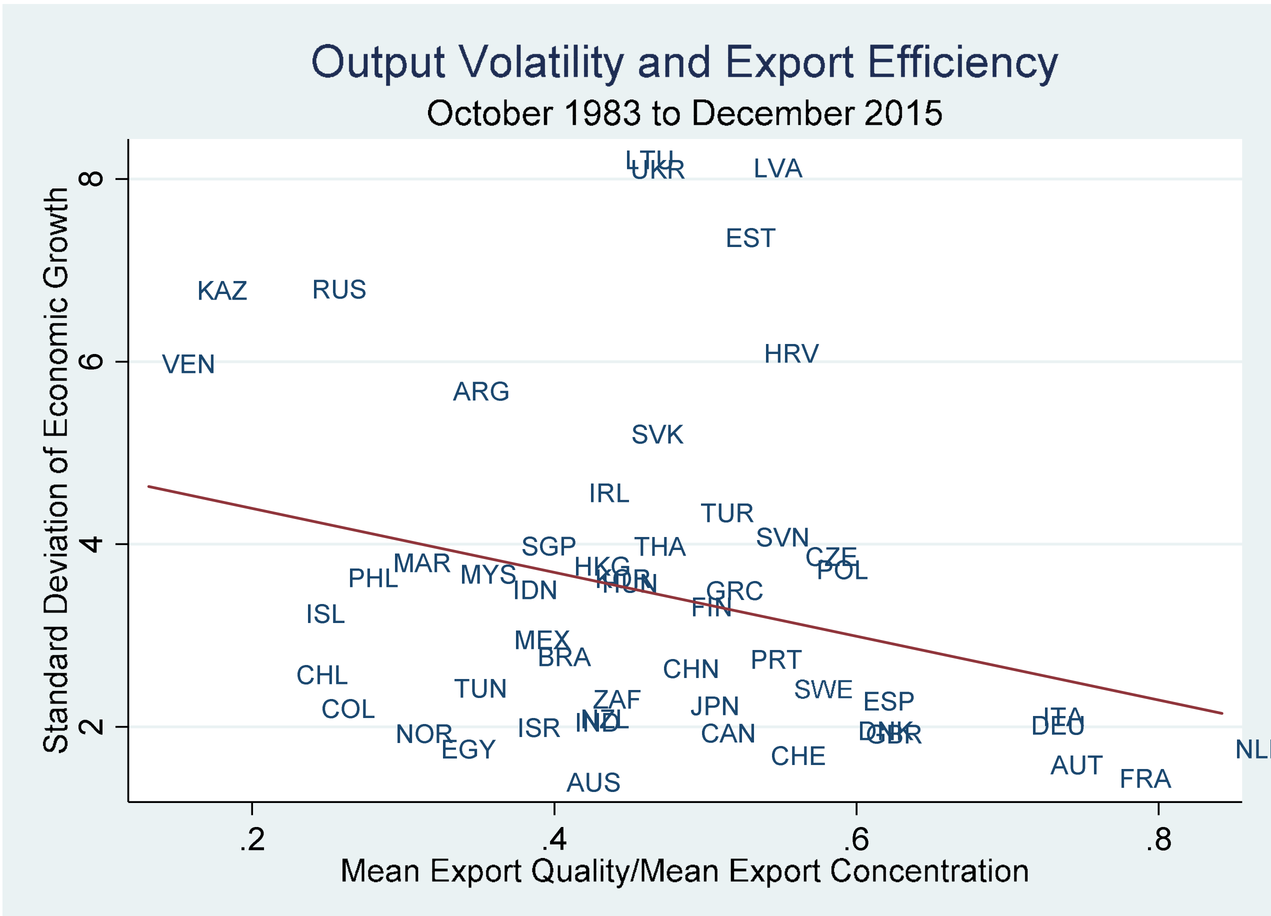


Table B.2. Carry Trade Portfolios

This table presents the average excess returns of the carry trade currency portfolios at time *t*, sorted on economy variables at time *t* – 1. Excess returns are expressed in percentage per annum. Newey and West (1987) standard errors with optimal lag selection, are reported in parentheses. The sample period is October 1983 to December 2015. The variable and estimate definitions [descriptions] are presented in Table 1 [Table A.1].

Panel A: All Economies

Portfolio	Q1	Q2	Q3	Q4	Q5	Q5 – Q1
Forward discount	-1.567	1.125	2.974	3.235	8.265	9.832
	(0.502)	(0.402)	(0.485)	(0.488)	(0.734)	(0.714)

Panel B: Higher-Income Economies

Portfolio	Q1	Q2	Q3	Q4	Q5	Q5 – Q1
Forward discount	-0.112	0.309	2.894	3.593	5.430	5.542
	(0.544)	(0.599)	(0.530)	(0.624)	(0.651)	(0.471)

Figure B.3. Export Concentration for the Case of Singapore

This figure presents a polynomial regression fit and a scatter plot for the relation between time and *Export concentration extensive* for the case of Singapore. The period for the shaded area is 1985 to 1995.

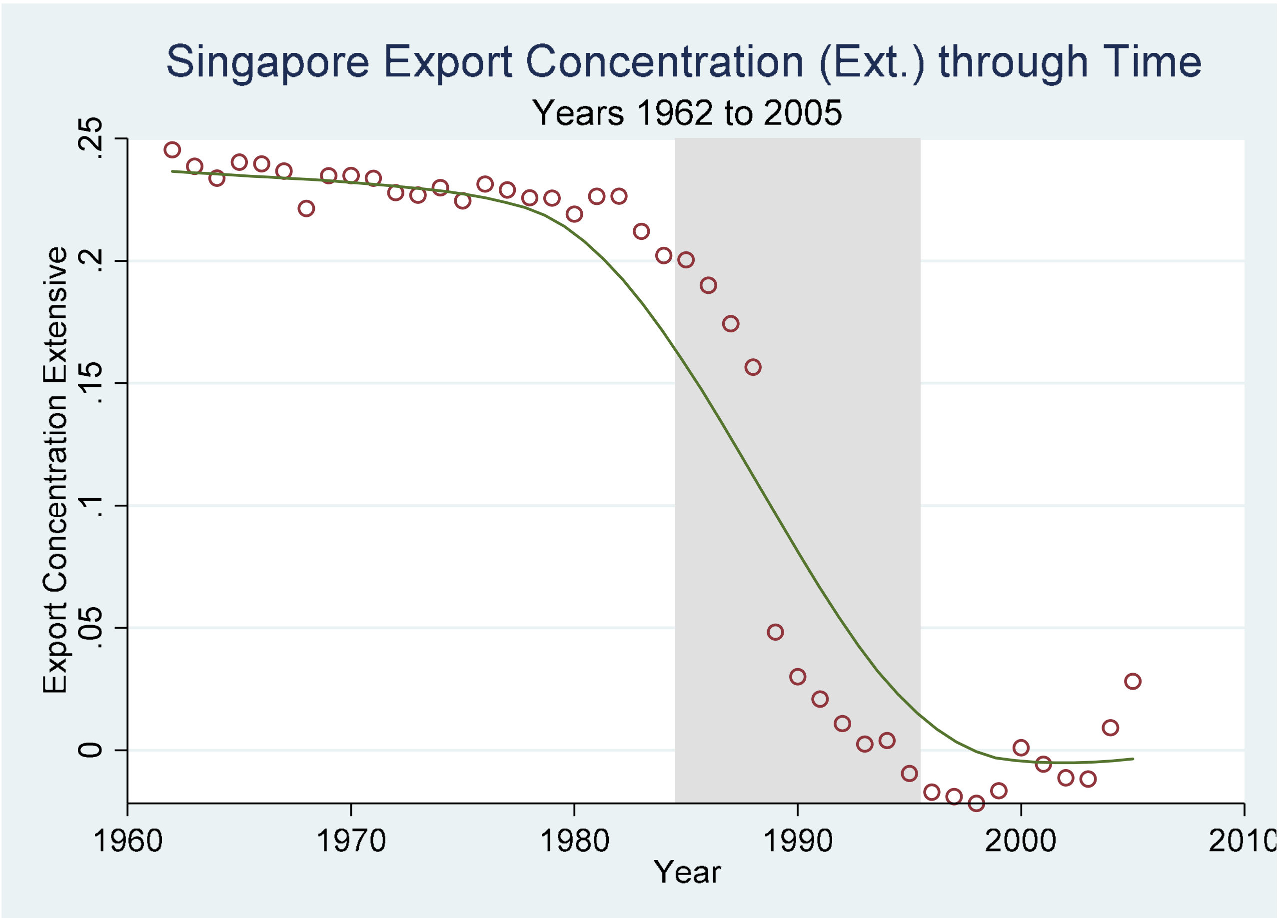


Figure B.4. The Singapore Exchange Rate through Time

This figure presents a polynomial regression fit and a scatter plot for the relation between time and the exchange rate for the case of Singapore. The period for the shaded area is 1985 to 1995.