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Growth and risk: A view from international trade

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Growth and Risk: A View from International Trade*

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Abstract

This paper studies the cross-country patterns of risky innovation and growth through the lens of international trade. We use a simple theoretical framework of risky quality upgrading by firms under varying levels of financial development to derive two predictions. First, the mean rate of quality growth and the corresponding cross-sectional variance of quality growth in a country are positively correlated. Second, both the mean and variance of quality changes are positively correlated with the country's level of financial development. We then test these two hypotheses using data on disaggregated (HS10) bilateral exports to the United States. The patterns in the data are consistent with the theory. The mean and the variance of quality growth are strongly positively correlated with each other. Countries with greater financial depth are systematically characterized by higher mean and higher variance in the growth of product quality. Our findings suggest a mean-variance trade-off in product quality improvements along the development path. Increases in financial depth do not imply lower variability of changes in the product space.

JEL Codes: F14, O3, O4
Keywords: Product quality, financial development, risk

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1 Introduction

Economic development is unavoidably a series of wagers; the returns to investments in physical, human, and knowledge capital are invariably accompanied by risk.[1] A substantial theoretical literature has argued that the evolution of a country's product basket along its development path (i.e., the evolution of the goods it produces and their quality) will depend on the relevant domestic and international institutions that allow agents to manage these risks. The lack of financial depth and the consequent inability of domestic producers to diversify risk implies that poorer countries will be less able to take on innovative but risky projects compared to rich countries.[2] Do countries, in practice, differ systematically in the evolution of their product space? If so, what do these differences depend upon? This paper explores these questions by studying cross-country patterns of product quality growth through the lens of international trade – in particular by looking at the evolution of countries' export baskets over time.

We begin in Section 2 with a theoretical framework that describes risky quality upgrading by firms in economic environments characterized by different levels of financial development. Each firm has a choice of either producing a basic variety of its product with certainty, or undertaking a risky investment required for a quality upgrade. As in Kugler and Verhoogen (2012), upgrading quality requires the firm to use higher-cost inputs (which could be either more skilled labor or more expensive materials). Firms are risk averse and their ability to diversify individual firm production risks through the financial system will determine their production choices. With low financial development, risks cannot be diversified, and entrepreneurs consume the ex-post profits of their firms. Under a high level of financial development, firms will diversify production risks and thus have a greater willingness to take on risky quality-upgrading projects. The framework yields two results. First, the mean rate of quality growth (across products) and the corresponding cross-sectional variance of quality growth in a country are positively correlated. Second, both the mean and the cross-sectional variance of quality changes in a country are positively correlated with the country's level

[1] See, for instance, Acemoglu and Zilibotti (1997), Kerr, Nanda, and Rhodes-Kropf (2014) and Manso (2016).

[2] See, for instance, Greenwood and Jovanovic (1990) who argue that financial intermediaries encourage high-yield investments and growth by performing dual roles: pooling idiosyncratic investment risks and eliminating ex-ante downside uncertainty about rates of return. Acemoglu, Antràs, and Helpman (2007) argue that weak domestic institutions that either exclude entrepreneurs, create additional uncertainty in the rules of the game, or make managing the implications of loss (for instance, bankruptcy law) difficult would also cause poorer countries to specialize in less risky products. Kletzer and Bardhan (1987), Beck (2002), Do and Levchenko (2007), and Hausmann, Hwang, and Rodrik (2007), among others, explore the links between financial development and patterns of production specialization.

of financial development. This suggests a mean-variance "tradeoff" in quality growth along the development path. Rapid improvements in product quality will be more likely feasible in countries with greater financial depth.

Section 3 evaluates these theoretical predictions using data on disaggregated (HS10) bilateral exports to the United States for 1990-2000. Product quality is proxied by unit values.[3,4] The advantage of using international trade data is that information on export prices and quantities is available at a much finer level of disaggregation than domestic production, especially for a large sample of countries. The implicit assumption is that the export basket of any country to the United States represents its technological frontier, and any domestic innovations in product quality are reflected in changes in unit values of products in the export basket to the United States. Further, given both our theoretical focus and data limitations, we focus on quality changes in existing products (i.e. the "intensive margin"), rather than the introduction of altogether new products (the "extensive margin").

Both of the main theoretical predictions discussed above find support in the data. The mean of quality growth and the variance of quality growth are strongly correlated with each other. Countries with greater financial depth exhibit systematically higher mean and higher variance in the growth of product quality. To establish the causal effect of financial development on growth, we use two strategies. We first use an instrumental variable for financial development: the age of its first stock market exchange as of the year 2002. This variable is positively correlated with the maturity of the financial markets because well-developed financial markets usually saw their first stock market established centuries ago. At the same time, the exclusion restriction is that the year the stock market was founded only impacts the present-day export quality growth and dispersion through the quality of the financial system. Second, we use an unexpected shock to financial development, the Asian Financial Crisis, to estimate the impacts of a sudden drop in financial development on product quality growth and dispersion. We employ the synthetic control method to find a comparison group for each country affected by the Asian Financial Crisis. Both exercises

[3] We follow a number of papers in the recent international trade literature that use unit values as a measure of quality, such as Schott (2004). In an influential contribution, Khandelwal (2010) proposes a methodology to estimate product quality that also incorporates information on market shares. However, Feenstra and Romalis (2014) find that "much of the variation in unit values is explained by quality, so quality-adjusted prices vary much less than the raw unit values or than the quality-adjusted estimates" of Khandelwal (2010) and others. Regardless, while our baseline analysis focuses on unit values, we show that our findings are robust to using Khandelwal (2010)'s methodology.

[4] The literature has variously explored the correlates and determinants of product quality. Schott (2004) and Hummels and Klenow (2005) show that unit values increase with the level of development. Hallak and Sivadasan (2013) argue that quality improvements represent the accumulation of "caliber," a factor of production distinct from productivity, while Sutton (2001) sees both quality and productivity as resulting from research and development.

confirm that the financial depth of a country drives its mean and variance in the growth of product quality.

Our results speak to a number of interrelated issues in the literature on economic growth, technology, and convergence across countries. It is well established that countries have not converged in their income levels – despite a range of theoretical mechanisms identified by the literature, such as international technology transfer and trade that could drive convergence. Our findings are consistent with the lack of income convergence across countries because they suggest that the combination of risk associated with technology upgrading and institutional weaknesses that prevent insurance against risk may be a barrier to technological adoption. The implied lack of convergence in product quality is also consistent with the well-known finding by Schott (2004) that higher-income countries exhibit a systematically higher quality of exports. At the same time, Wang and Wei (2010) show that a rapidly converging country like China also experiences rapid quality upgrading of its exports.

Our results also inform the literature on technological change, growth and financial depth, which has argued that technological change may be risky and that the inability to diversify this risk impedes technological progress. For instance, Doraszelski and Jaumandreu (2013) find that engaging in research and development roughly doubles the degree of uncertainty in the evolution of a producer's productivity level. Foster and Rosenzweig (2010) argue, in the context of small-scale agriculture, that "the incompleteness of insurance and credit availability play an important role in delaying the adoption of profitable new technologies.." Relatedly, Gorodnichenko and Schnitzer (2013) provide evidence that financial constraints affect the incentives of firms to innovate, which ultimately limits the ability of poor countries to catch up technologically with rich ones. Our finding that quality growth is higher in countries with greater financial depth complements these results.

Overall, our paper supports the view that the systematic differences in the evolution of countries' product baskets are partly due to disparities in financial development. The upgrading of product quality requires taking risks. The inability to diversify and mitigate these risks is a barrier to development.

2 Analytical Framework

Setup There are two periods, indexed by $t = 0, 1$. There is a continuum of monopolistically competitive firms of mass 1 indexed by $k \in [0, 1]$, each with the ability to produce a unique variety. Each firm faces isoelastic demand for its product:

$$x_t(k) = Aq_t(k)^{\varepsilon-1}p_t(k)^{-\varepsilon} \tag{1}$$

where $x_t(k)$ is the quantity demanded, $p_t(k)$ is the price, $q_t(k)$ is a variety-specific demand shifter which we think of as quality, and A is market-wide demand shifter.[5]

Firms produce with an exogenously given non-time varying unit input requirement $a(k) \in [a_{min}, 1]$ with finite support, and firm k can convert $a(k)$ units of the input bundle into one physical unit of its product. There are no fixed costs for setting up production (or, alternatively, those fixed costs have already been paid by all firms). Firm k's bundle at time t costs $c_t(k)$. While we do not need to take an explicit stand on the composition of the input bundle, it can consist of labor (possibly differentiated by skill), capital, and material inputs (both possibly heterogeneous). All inputs are generically firm-specific, and thus the overall cost of the input bundle $c_t(k)$ is firm-specific as well.

Standard profit-maximization steps given demand (1) lead to the well-known result that prices are a constant markup over marginal cost,

$$p_t(k) = \frac{\varepsilon}{\varepsilon - 1} a(k) c_t(k)$$

and variable profits are a constant fraction of firm sales,

$$\pi_t(k) = \frac{A}{\varepsilon} \left(\frac{\varepsilon - 1}{\varepsilon} \frac{q_t(k)}{a(k) c_t(k)} \right)^{\varepsilon - 1}.$$

We assume that this set of firms is small relative to the overall size of this market, so that their behavior, even as a group, does not affect the overall market demand shifter A.[6] We also assume that A does not vary across periods. This market demand could in principle be a combination of domestic and foreign demands.

Risky quality upgrading At $t = 0$, all firms are constrained to produce a basic product with the basic input bundle. Without loss of generality, we normalize the cost of the basic input bundle $c_0(k)$ to 1, and the quantity shifter $q_0(k)$ of the basic product to 1 as well. The firm profits when selling basic product are:

$$\pi_b(k) = \frac{A}{\varepsilon} \left(\frac{\varepsilon - 1}{\varepsilon a(k)} \right)^{\varepsilon - 1},$$

[5]The utility function underlying this demand for an individual variety is

$$\left[\int_{\Omega} (q(k) x(k))^{\frac{\varepsilon - 1}{\varepsilon}} dk \right]^{\frac{\varepsilon}{\varepsilon - 1}}.$$

The term A, which the firm treats as a constant, subsumes the total expenditure on all varieties and the ideal price index over all varieties k.

[6]Precisely, we assume that the continuum of firms analyzed here is a small subset of the total set of varieties Ω that enters the utility function specified in footnote 5.

where the subscript b stands for "basic."

For $t = 1$, firms have a choice over product quality that is subject to uncertainty. In particular, each firm has the option to keep producing under basic quality. This choice carries no additional costs and no uncertainty.

Alternatively, firms can invest in risky quality upgrading. They pay a fixed cost f before the realization of uncertainty. This fixed cost can be anything that has an impact on the consumer valuation of the product: product development, market research to determine the optimal product design, advertising expenditure, etc. With probability ϕ the investment is successful, and consumers like the product. In that case, the firm's quality becomes $q_1(k) = q > 1$. At the same time, in order to produce a higher quality product, the firms need better inputs. These could be higher-end material inputs or higher-skilled workers. To produce a higher quality final product, the cost of the required input bundle is $c_1(k) = c > 1$.[7] When the quality-upgrading investment is successful, the firm thus earns profits of:

$$\overline{\pi}(k) = \frac{A}{\varepsilon}\left(\frac{\varepsilon-1}{\varepsilon}\frac{q}{a(k)c}\right)^{\varepsilon-1} - f.$$

However, with probability $1-\phi$ the quality-upgrading investment is not successful, and consumers are not convinced that the firm's product is of higher quality. In that case, the firm reverts back to the basic product, and its profits are:

$$\underline{\pi}(k) = \frac{A}{\varepsilon}\left(\frac{\varepsilon-1}{\varepsilon a(k)}\right)^{\varepsilon-1} - f,$$

which is of course simply equal $\pi_b(k) - f$.[8]

To make the analysis interesting and obtain the main result in the simplest way, we make the following assumption.

$$\underline{\textbf{A1:}} \quad \phi\overline{\pi} + (1-\phi)\underline{\pi} > \pi_b \quad \forall k.$$

This assumption states that expected profits from quality upgrading are greater than basic profits, for all firms. Of course, if this were not the case, then the safe project has a higher mean return than the risky project, and the risky project never gets implemented. Expressed

[7] This assumption implies that, consistent with empirical evidence, firms selling higher quality products charge higher prices. Kugler and Verhoogen (2012) document the positive relationship between firms' product quality and unit costs.

[8] One might ask whether the firm can still pass on the increase in costs due to a failed quality investment to the consumers. When the quality-upgrading project fails, one can think of this outcome as a firm having two technologies to serve the same demand (for the low-quality good): the basic technology with the unit cost of 1, and the upgraded technology with a unit cost of $c > 1$. The firm will of course choose the cheaper basic technology. Forcing the firm to nonetheless use the more expensive unit cost c even if the quality upgrade fails makes the results starker because in that case, $\underline{\pi}(k)$ is even lower.

in terms of exogenous parameters of the model, A1 amounts to:

$$\frac{\phi A}{\varepsilon}\left(\frac{\varepsilon-1}{\varepsilon}\right)^{\varepsilon-1}\left[\left(\frac{q}{c}\right)^{\varepsilon-1}-1\right] > f.$$

Obviously, a necessary condition for A1 to be satisfied is that $q > c$: the increase in demand the firm gets from a successful quality-upgrading effort more than compensates for the increase in unit cost that it must incur.

Financial markets As in Greenwood and Jovanovic (1990), firms (or more precisely, the shareholders of firms) are risk averse. They make the quality-upgrading choice for their firm and financial market portfolio decisions (if any) to maximize expected utility

$$maxE(u(y)),$$

where y is the ex post income, and $u(.)$ is a standard concave utility function. The ex-post income need not coincide with firm profits, as will become clear below.

To make the analysis interesting and state the results in the clearest way, we make the following assumption:

$$\underline{\textbf{A2:}} \quad \phi u(\overline{\pi}) + (1-\phi)u(\underline{\pi}) < u(\pi_b) \quad \forall k. \tag{2}$$

This assumption states that the expected utility when consuming profits from quality upgrading is lower than the expected utility of consuming basic profits, for all firms. If this were not the case, agents would always choose the quality upgrade, irrespective of the financial market structure. Of course, A2 can be satisfied with a sufficiently concave $u(.)$ even as A1 is satisfied simultaneously.[9]

Because risks from quality upgrading projects are idiosyncratic across firms, they have an incentive to diversify those risks through the financial market by selling their shares and buying a mutual fund that owns all the firms in this economy. Frictions potentially prevent perfect risk diversification. In particular, each firm owner can only sell a fraction $\psi \in [0, 1]$

[9] To get a sense of whether A1 and A2 can be jointly satisfied for reasonable parameter values, we can do a back-of-the-envelope calculation. Assume utility is CRRA with the relative risk aversion of γ:

$$u(y) = \frac{y^{1-\gamma}-1}{1-\gamma}.$$

Assume that the quality upgrading project succeeds with the probability $\phi = 0.5$. Pick the profits in case of success and failure to be such that the expected profit increase from a quality upgrading project is 10% (relative to the $t = 0$ basic profit π_b) and the standard deviation of profit growth is 0.3 (set to match the standard deviation of sales growth for a typical firm, e.g. di Giovanni, Levchenko, and Méjean, 2014). Under these values, A1 and A2 are simultaneously satisfied for any $\gamma > 2.486$, a reasonable risk aversion.

of the equity of the firm to the financial markets. Per standard arguments, this can be due to the limited ability of the financial system to monitor actions or outcomes, and/or to the inability of the legal system in the country to enforce contracts. With the proceeds of this sale, the firm owner buys the economy-wide mutual fund that pays the expected firm profits. Since there is a continuum of firms, the law of large numbers operates exactly and there is no uncertainty in aggregate. Because the mutual fund perfectly diversifies idiosyncratic risk, it is willing to pay ψ times the firm's expected profits for the shares that the firm sells. Thus, the firm owner's total income if the quality upgrading project succeeds is $\psi\left(\phi\overline{\pi}+(1-\phi)\underline{\pi}\right)+(1-\psi)\,\overline{\pi}$, and $\psi\left(\phi\overline{\pi}+(1-\phi)\underline{\pi}\right)+(1-\psi)\,\underline{\pi}$ if it fails.

The parameter ψ captures the level of a country's financial development. When it is low, various frictions prevent firms from selling their shares to outside investors, limiting the diversification of risks. When ψ is high, firm owners' can sell much of their equity in the firm, limiting their exposure to idiosyncratic risk.

Equilibrium production allocations We now state the main predictions of the model.

Proposition 1 *Suppose that there are $N > 1$ countries that differ among themselves in their level of financial development ψ. There is a threshold level of financial development $\widetilde{\psi}$ such that in countries with better financial development ($\psi > \widetilde{\psi}$), all firms invest in quality upgrading projects, and in countries with worse financial development ($\psi < \widetilde{\psi}$), no firms invest in quality upgrading. As a result, in the cross-section of countries:*

1. *The mean growth rate in firm price and the cross-sectional variance of price changes are positively correlated: the countries with a lower mean growth rate in price also exhibit a lower variance of price growth rates.*

2. *Both the mean price change and the cross-sectional variance of price changes are positively correlated with financial development. High financial development countries have both higher average growth rates of prices and a higher variance of growth rates of prices.*

Proof: Appendix A.

The low and high financial development economies will reach different real allocations. To convey the intuition, consider the polar extreme cases of no finance at all ($\psi = 0$), and perfect finance ($\psi = 1$). With zero financial development, each firm consumes its own ex-post profits. Thus, when making the quality upgrading decision, it compares the expected utility from consuming the profits under quality upgrading (the left-hand side of eq. (2)) to the expected utility from consuming the profits from selling the basic product (the right-hand side of eq. (2)). Under A2, all firms in the low-financial development economy will choose not to engage in quality upgrading. The price charged by each firm will be the same in the two periods: prices will be equal to $p_0(k) = p_1(k) = \frac{\varepsilon}{\varepsilon-1}a(k)$. Thus both the average price change and the cross-sectional variance of price changes will be zero: $E(\Delta p(k)) = 0$ and $Var(\Delta p(k)) = 0$, where $\Delta p(k) \equiv p_1(k)/p_0(k) - 1$ is the growth rate in the unit price: the theoretical counterpart of the object of the empirical analysis below.

When $\psi = 1$, all firms will be consuming the expected profits at $t = 1$. By A1, each firm will choose to upgrade quality. The average proportional change in goods prices and the cross-sectional variability in price changes will be different from the low financial development case. Some of the prices (those for firms with unsuccessful quality upgrading outcomes) will be $p_1(k) = p_0(k) = \frac{\varepsilon}{\varepsilon-1}a(k)$, and thus their growth rate will be zero: $\Delta p(k) = 0$. On the other hand, for the successful firms, the price will be $p_1(k) = \frac{\varepsilon}{\varepsilon-1}a(k)c$, and thus the proportional change will be $c-1$. Then mean price change, $E(\Delta p(k)) = \phi(c-1) + (1-\phi)0 = \phi(c-1)$, is higher than in the low financial development equilibrium. There will also be cross-sectional variation in prices. The variance of prices changes across firms $Var(\Delta p(k)) = \phi((c-1) - \phi(c-1))^2 + (1-\phi)(0-\phi(c-1))^2 = \phi(1-\phi)(c-1)^2$, which is strictly positive.

The proof of the proposition shows that the no-diversification outcome applies to all countries below a threshold level of financial development $\widetilde{\psi}$, and the full diversification outcome applies to countries above that threshold.

3 Evidence

Proposition 1 summarizes the main theoretical results on the correlation between mean quality growth and variance of quality growth as well as the positive relationship between the mean and the variance of quality growth and financial development in a cross-section of countries. We now turn to empirical evidence for these predictions.

3.1 Data

We use data from disaggregated (HS10) bilateral exports to the United States from 1989 to 2001, sourced from the NBER Trade Data Set, a detailed description of which is provided by Feenstra, Romalis, and Schott (2002). The data sum across U.S. ports and modes of transportation. In total, there are 16,926 HS10 products and 178 countries. The number of products per country ranges from 1 to 9907, with a mean number across countries of 5385. We focus on manufacturing industries (SITC 5-8).

As is well known, the trade data in the NBER data set are quite noisy. In addition to data reporting and entry errors, there are product classification errors due to underlying product heterogeneity. Further, as Besedes and Prusa (2006) note, there are changes in product categorization across time. For instance, a given HS10 product category may split into several HS10 codes over time, and alternately, multiple HS10 codes may be merged into one HS10 category due to the evolution of new products as well as the attrition of old ones. To deal with the noise in the data, we trim the data along two dimensions. First, we exclude all observations for which the dataset reports a quantity of one unit or total value less than $7500 1989 dollars. Second, as in Khandelwal (2010), we remove varieties with extreme unit values that fall below the 5^{th} percentile or above the 95^{th} percentile within the industry. To mitigate the effects of outlier observations on our dispersion measure, we drop those goods for which the growth rate of quality on an annual basis is greater than 2 (that is, those products whose unit value more than doubled).[10] These filters, taken together, result in a loss of 7.99% percent of trade volume. The robustness checks consider alternative data filters and data-trimming criteria, as discussed below.

Product unit values (trade value divided by trade quantity) serve as a proxy for product quality. To make statements about a country's innovations in product quality, we implicitly assume that the export basket of any country to the United States represents the exporting country's technological frontier. Thus any domestic innovations in product quality in an exporting country are reflected in changes in the unit values of products in its export basket to the United States. Many studies document that exporting firms are more likely to hire high-skilled workers and produce higher unit-value products relative to non-exporters (e.g Bernard et al., 2007; Verhoogen, 2008). Moreover, firms tend to export products with higher unit value to higher-income countries (e.g Hallak, 2006; Manova and Zhang, 2012). Therefore, the export basket to the United States is likely a good proxy for the country's technological frontier.

The source for financial depth data is Beck, Demirgüç-Kunt, and Levine (2010). Our main indicator of financial development is Private Credit by Deposit Money Banks, expressed as a share of GDP. We use the Deposit Money Bank Assets as a share of GDP as a robustness check.

Denote the unit value of product i in country c at time t by u_{ict}. To capture the central tendency of quality growth in any exporting country c, we calculate first the time-average of

[10] In a separate calculation, we also consider only those goods which additionally saw no downward movement in unit values as it is not clear that they represent a downgrading of quality. For instance, a fall in unit values could be a result of a reduction in markups. Results were similar and are available upon request.

the growth rate of unit values of its exports of product i across T consecutive years:

$$\bar{u}_{ic} = \frac{1}{T}\sum_{t=1}^{T}\dot{u}_{ict} = \frac{1}{T}\sum_{t=1}^{T}\frac{(u_{ict+1} - u_{ict})}{u_{ict}},$$

where $\dot{u}_{ict} = (u_{ict+1} - u_{ict})/u_{ict}$ is the growth rate of unit values of product i in country c at time t. We then take the mean of this growth rate across I_c products of this exporting country:

$$\mu_c = \sum_{i=1}^{I_c}\frac{\bar{u}_{ic}}{I_c}.$$

The dispersion in quality growth across products in c is measured as the standard deviation across growth rates of the I_c products exported by country c:

$$\sigma_c = SD(\bar{u}_{ic}).$$

3.2 Main Results

Figure 1 plots μ_c against σ_c. Panel (a) restricts the sample to only those countries that export more than 50 products to the United States.[11] There is a strong positive relationship between the mean rate of quality growth μ_c and the standard deviation of quality growth σ_c. Panels (b) and (c) plot μ_c against σ_c restricting the sample to countries with more than 100 products exported and more than 500 products exported to the United States, respectively. The positive link between μ_c and σ_c holds regardless of whether we consider an expanded set of countries exporting to the United States or the smaller group of countries that export a larger range of products.

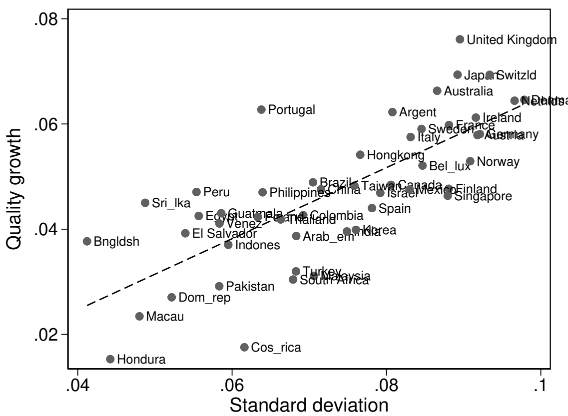
To assess statistically the relationship between the growth rate of product quality and the dispersion in product quality growth as predicted by the theory, we examine the correlation between μ_c and the standard deviation in quality growth, σ_c using the following bivariate specification:

$$\mu_c = \beta\sigma_c + \epsilon_c.$$

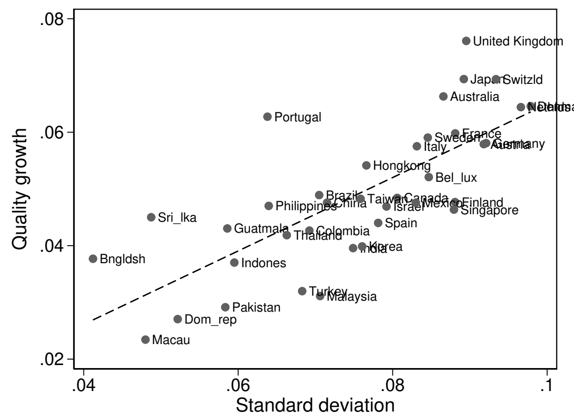
where ϵ_c is the error term. Columns 1, 2, and 3 of Appendix Table D.2 report the underlying regression estimates. The correlation between μ_c and σ_c is positive and statistically significant at the 1 percent level in every case. The relationship is also economically significant: a 1 percentage point increase in the value of σ_c is associated with about a 0.7-1.2 percentage point increase in the value of μ_c.

[11] This is the main sample for the baseline estimations below. Appendix Table D.1 lists the countries.

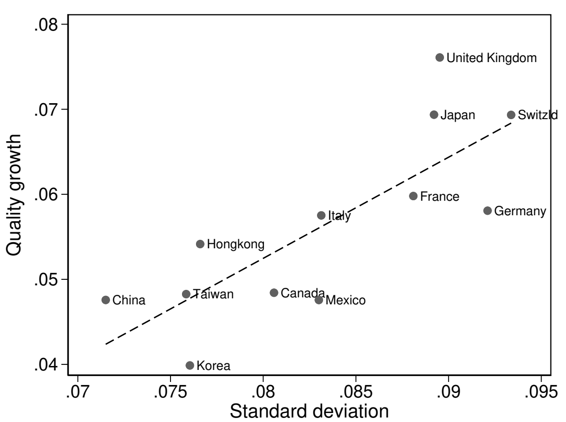
Figure 1: Quality Growth vs. Dispersion



(a) Countries with >50 Products



(b) Countries with >100 Products



(c) Countries with >500 Products

Notes: This figure plots the mean quality growth against the standard deviation of quality growth for countries that export at least 50 (panel a), 100 (panel b), or 500 (panel c) HS10 products to the US.

3.2.1 Controlling for Sectoral Composition

The pattern documented above may be due to inherent differences across broad sectors in their mean and variance. To explore the role of the sectoral dimension, we compute μ_{pc} and σ_{pc} for countries and broad sectors p, and project these on the country and broad sector fixed effects:

$$\mu_{pc} = \delta_c^{\mu} + \delta_p^{\mu} + \epsilon_{pc}^{\mu} \quad (3)$$

$$\sigma_{pc} = \delta_c^{\sigma} + \delta_p^{\sigma} + \epsilon_{pc}^{\sigma}. \quad (4)$$

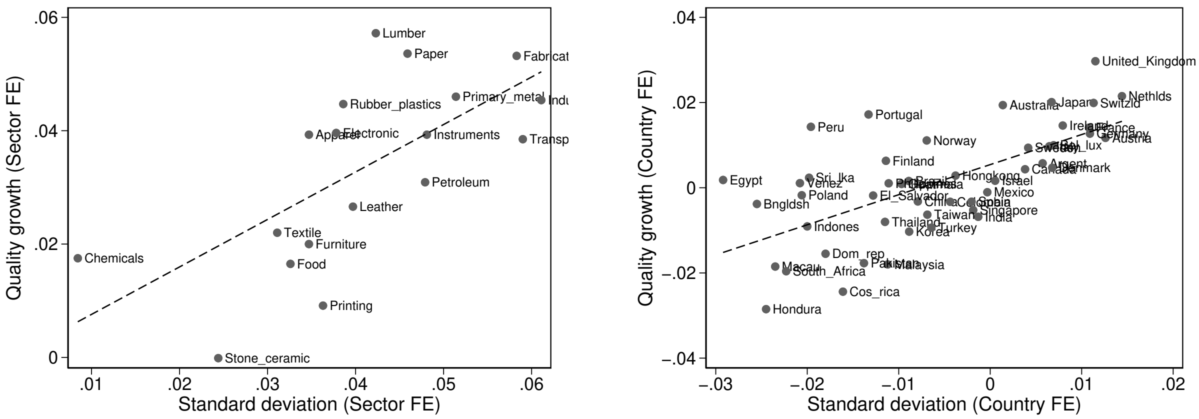
Panel (a) of Figure 2 plots the sector fixed effects for the mean and standard deviation δ_p^{μ} and δ_p^{σ} against each other. It is indeed the case that across broad product groups, the mean-variance relationship is positive. For instance, instruments and fabricated metal products have both higher mean and higher variance than food products and textiles. This relationship is statistically significant, with the coefficient and standard error reported in column 4 of Appendix Table D.2.

Since richer countries also generally produce more sophisticated products, we may therefore worry that product composition rather than country characteristics drive our results. However, country differences are equally pronounced after controlling for product group fixed effects. Panel (b) of Figure 2 plots the country effects δ_c^{μ} and δ_c^{σ} resulting from estimating (3)-(4). Again, the relationship is positive, with high-income countries displaying higher mean and variance profiles. Column 5 of Appendix Table D.2 confirms the statistical significance of the relationship. The findings suggest that countries with high mean and variance combinations not only produce a basket containing on average higher risk-return sectors but also within broad sectors choose higher-risk investments.

Lastly, an interesting question is what is the relative explanatory power of the sector vs. country dimensions in accounting for the total variation in μ_{pc} and σ_{pc} across country-sectors. Appendix Table D.3 reports the results of an Analysis of Variance (ANOVA) exercise associated with equations (3)-(4). For μ_{pc}, the partial sum of squares associated with all the fixed effects is 0.327, of which 0.104 is accounted for by the country effects, and 0.220 by sector effects. So the explanatory power of the sector effects in absorbing the existing variation is about double that of the country effects. For the standard deviation, the relative importance of the country vs. sector effects is about equal.

The ANOVA echoes the results reported in Figure 2: although sector effects account for half to two-thirds of the explained variation in country-sector quality growth, country-level factors still explain up to half, and the positive relationship between quality growth and dispersion across countries is still evident after accounting for the sectoral variation. Calculating the relative contribution of the composition of the export basket vs country

Figure 2: Quality Growth vs. Dispersion: Sectoral Dimension



(a) Sector Fixed Effects **(b) Country Fixed Effects**

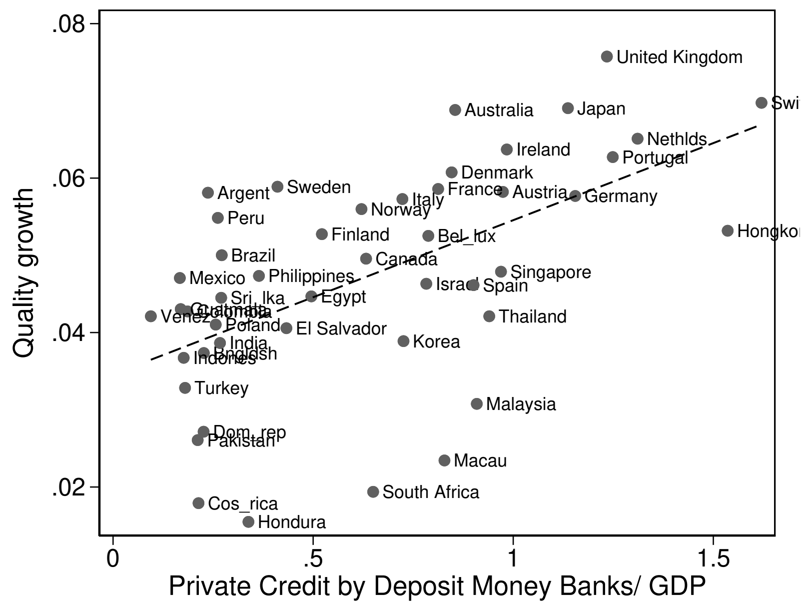
Notes: Panel (a) plots the product group fixed effects for the mean δ_p^μ and standard deviation δ_p^σ. Panel (b) plots the country fixed effects for the mean δ_c^μ and standard deviation δ_c^σ. Both sets of fixed effects result from estimating (3)-(4). The sample is countries that export at least 50 HS10 products to the US. "Sectors" refer to SIC-2 industries.

dimensions in accounting for the total variation in μ_{pc} and σ_{pc} speaks imperfectly to ongoing debates around industrial policies: how much should a country be concerned with its sectoral specialization vs. improving the enabling environment in fomenting growth. Further, if there is endogenous selection into sectors, this exercise probably overstates the importance of the sectoral dimension. That is, if more financially developed countries also select into more risky sectors, the overall importance of country factors is likely to be higher, and of sectoral specialization lower, than suggested by the simple ANOVA.

3.2.2 Robustness to an Alternate Measure of Product Quality

We next consider an alternate measure of product quality and product quality growth. In an important paper, Khandelwal (2010) has argued that unobserved supply shocks can cause price differentials that do not correspond to differences in quality. The paper proposes a method to filter the raw unit value measures through a demand system in order to get an improved measure of product quality. A product is judged to have higher quality if the demand for the good is higher, controlling for prices. In a nutshell, a better measure of quality than the price (or unit value) would be market share conditional on price, since a higher unit value with little market share may well represent higher costs rather than higher quality. We follow the Khandelwal (2010) procedure and back out these measures of quality. The Appendix contains a brief summary of the procedure; the reader is referred to

Figure 3: Quality Growth vs. Financial Depth



Notes: This figure plots the mean quality growth against financial development for countries that export at least 50 HS10 products to the US. Slope = 0.02 (t-stat=5.35).

the original paper for the full detail. The correlation between the two measures is around 0.4.[12] Appendix Table D.4 shows that the correlation between risk and return is robust to using the filtered quality measure.

3.2.3 Financial Depth and Product Quality

An important feature of Figure 1 is that high values of μ_c and high values of σ_c are generally seen together for countries with high income levels. For instance, the high mean-variance countries include the United Kingdom, Japan, Denmark, and Switzerland, and the low mean-variance countries include the Dominican Republic, Pakistan, and Honduras. This is broadly consistent with our theoretical hypothesis that countries with greater financial depth – generally high-income countries – will have large mean-variance combinations for unit value growth. Figure 3 presents suggestive support for this hypothesis by showing a positive unconditional relationship between quality growth and financial depth proxied by Private Credit by Deposit Money Banks.

To formalize this further, we estimate the following relationship between unit value

[12] Both measures are also positively correlated with the exporting country's income, as reported in previous studies.

growth and dispersion and financial development:

$$y_c = \beta_0 + \beta_1 FIN_c + \mathbf{X}\boldsymbol{\gamma} + \eta_c \quad (5)$$

where y_c is the country-level outcome variable that could be either μ_c or σ_c, FIN_c denotes the level of financial development in country c, and $\mathbf{X}$ is a vector of controls. We restrict the sample the same way as in Panel (a) of Figure 1: the countries that export at least 50 HS10 products to the US, listed in Appendix Table D.1.

Identification It may be that unit value growth and financial development are both driven by omitted factors. Moreover, the growth of product quality might also spur further development in the financial markets, leading to reverse causality. To establish the causal effect of financial development on growth, we follow two strategies. First, we use an instrumental variable for financial development. Second, we present evidence using an unexpected shock to financial development, the Asian Financial Crisis, to document the impacts of financial development on product quality.

Our instrument for the financial development of a country is the age of its first stock market exchange as of the year 2002. This variable is positively correlated with the maturity of the financial markets because well-developed financial markets usually saw their first stock market established centuries ago. For example, the Copenhagen Stock Exchange was established in 1625, the New York Stock Exchange was established in 1792, while the Dominican Stock Exchange was founded as recently as 1991. The date of establishing a stock market predates our sample period, thus ruling out direct reverse causality. Moreover, the age of the stock market should only matter for contemporary product quality growth through its effect on the maturity of financial markets. Therefore the IV also plausibly meets the exclusion restriction. Appendix C presents further details on the instrument.

Table 1 reports the results. Column 1 shows the OLS. Financial development positively correlates with average quality growth. Our main controls are the log of per capita income and a dummy for whether the country is an offshore center. We control for GDP per capita because financial development and product quality could both increase with income levels. Moreover, countries such as Singapore, Luxembourg, and Switzerland are financial off-shoring centers and thus might exhibit very high rates of financial development without corresponding quality growth. We control for this by including an indicator variable for off-shoring locales.[13] Conditional on these control variables, our financial depth proxies emerge as strongly significant for μ_c. Financial variables correlate positively with σ_c; however, the

[13]Offshoring locales are Macao, Singapore, Costa Rica, Dominican Republic, Malaysia, Hong Kong, Luxembourg, Switzerland, and South Africa. See International Monetary Fund (2006) for a complete discussion.

Table 1: Product Quality and Financial Depth

	Mean				SD			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	2SLS	2SLS	2SLS	OLS	2SLS	2SLS	2SLS
Financial Variable	0.014***	0.044***	0.036***	0.033**	0.004	0.048***	0.042***	0.031**
	(0.004)	(0.008)	(0.006)	(0.013)	(0.004)	(0.009)	(0.007)	(0.014)
Off-shore	-0.018***		-0.022***	-0.021***	-0.008*		-0.014**	-0.013**
	(0.004)		(0.004)	(0.004)	(0.004)		(0.006)	(0.006)
Ln(GDP per capita)	0.005***			0.001	0.009***			0.004
	(0.001)			(0.003)	(0.002)			(0.003)
Constant	0.001	0.020***	0.029***	0.023	-0.005	0.043***	0.049***	0.025
	(0.009)	(0.006)	(0.004)	(0.016)	(0.012)	(0.006)	(0.005)	(0.020)
N	46	46	46	46	46	46	46	46
First Stage F-Stat		40.453	46.697	11.474		40.453	46.697	11.474

Notes: This table reports the results of estimating equation (5). "Financial Variable" refers to the "Private Credit by Deposit Money Banks/GDP" ratio. Robust standard errors are in parentheses. ***: significant at the 1% level; *: significant at the 5% level; *: significant at the 10% level. The sample is countries with at least 50 products exported to the US. Locales captured by off-shore dummy==1 are Macao, Singapore, Costa Rica, Dominican Republic, Malaysia, Hong Kong, Luxembourg, Switzerland, and South Africa. The instrument variable for the financial depth variable is the age of a country's oldest stock exchange as of 2002.

results are not significant, probably due to a small number of observations and the lack of statistical power.

Columns (2) to (4) of Table 1 report the two-stage least squares estimates, where the dependent variable is the growth of product quality. The first stage results confirm that the age of a country's first stock market is correlated with the financial market depth, as the F statistics are all greater than 10. The 2SLS results show that better-developed financial markets lead to significantly faster growth of product quality in a country. Further controlling for off-shoring financial centers and the per capita GDP in column (4) somewhat reduces the impact of the financial depth. Nevertheless, the effect is still significantly positive. The impact of the financial market is also economically substantial. The point estimate of 0.33 in column (4) implies that a one standard deviation change in the private-credit-to-GDP ratio increases μ_c by 0.93 standard deviations.[14]

The maturity of the financial market also leads to a higher dispersion of product quality, as shown in Columns (6) to (8) of the same table. Controlling for the off-shore status and per capita GDP, a one-standard-deviation improvement in financial depth increases σ_c by 0.81 standard deviations.[15]

[14] In the estimation sample, the standard deviation of "private credit by deposit money banks/GDP" is 0.407. The standard deviation of μ_c is 0.0144. Therefore, according to column (4), the impact of one standard deviation of the financial variable is $0.407 * 0.033/0.0144 = 0.93$.

[15] The standard deviation of σ_c across 46 economies is 0.0156. Therefore, according to column (8), the impact is $0.407 * 0.031/0.0156 = 0.81$.

The results above are robust to many variations in the estimation specifications, reported in the appendix. Appendix Table D.5 shows the results using alternative measures of financial depth. Panel (a) of Appendix Table D.6 reports the results using alternative quality growth and dispersion measures. One might be concerned that our results are driven by local financial hubs such as Singapore and Hong Kong. Panel (b) of the same table shows that our results are robust if we drop these economies or similar small economies that do not specialize in manufacturing industries, such as Macau and Luxembourg. The same panel also reports specifications that control for total GDP and the overall trade openness. Panel (c) of the table explores the impacts of the data cleaning restrictions discussed earlier. In the baseline results, we drop the country-product-year cells whose total export to the U.S. is smaller than $7,500, and the $\dot{u}_{ict} > 2$. The panel shows that our results are robust to variations in these restrictions.

Sector-level evidence We also estimate the relationship between unit value growth/dispersion and financial development in a country-industry sample. In these exercises, we extend the regression in equation (5) to:

$$y_{pc} = \beta_0 + \beta_1 FIN_c + \mathbf{X}\boldsymbol{\gamma} + \delta_p + \eta_{pc}, \tag{6}$$

where y_{pc} is μ_{pc} or σ_{pc}, and δ_p is the sector fixed effects at the SIC-4 level. We cluster the standard errors at the country level. Appendix Tables D.7 and D.8 report the results organized similarly to Table 1. The main conclusion is unchanged: conditional on sector fixed effects, countries with better financial markets experience faster quality growth and greater dispersion.

Asian Financial Crisis The second strategy to establish causality exploits an unexpected financial shock, the Asian Financial Crisis (AFC) in 1997. We document that the countries affected by the financial crisis experienced a reduction in quality growth and dispersion. We highlight the impacts of the AFC by combining a difference-in-differences specification with synthetic control methods to find an appropriate control group for the affected countries.

The 1997 Asian Financial Crisis was a period of turmoil in the Asian financial markets that started in July 1997 in Thailand. The shocks quickly spread to other East and Southeast Asian countries within weeks, leading to capital flight, currency devaluation, and stock market crashes. The AFC was largely unexpected at the time and was mostly contained within the Asian economies. The shock was also short-lived, as the Asian markets quickly recovered in 1998.

The unexpected and drastic financial shock provides a unique opportunity to study the relationship between financial markets and product quality. The natural approach is to ask:

did the countries affected by the AFC experience a decline in product quality growth and dispersion after the shock compared to the unaffected countries? Employing a difference-in-differences estimator is challenging in this context: while the treatment group is clear, an appropriate control group of countries is harder to identify. The affected Asian economies include high-income countries such as Japan and Korea and mid and low-income economies such as China and Indonesia. It is unclear what groups of countries would exhibit similar trends in product quality growth and dispersion.

To properly construct comparable control countries, we follow Abadie and Gardeazabal (2003) and Abadie, Diamond, and Hainmueller (2010) and implement a synthetic control method. To do so, we first restrict the countries using the same criteria as in the previous IV exercise and define the time period to be between 1991 and 2001. The resulting panel data contains 49 countries over 11 years.[16] We define the "treatment group" as the countries affected by the AFC according to Laeven and Valencia (2018): China, Indonesia, Japan, Korea, Malaysia, Philippines, and Thailand. We define the event date as 1997 and construct the synthetic control using three matching variables before the event date: 1) the per capita GDP to capture the general level of economic development, 2) the trade openness measured as (export + import)/GDP to capture a country's exposure to the global market and 3) the treatment variable itself: the mean or standard deviation of product quality before the AFC. The synthetic control is a weighted average of non-treated countries in our sample, where the weights are selected optimally to minimize the differences in the matching variables between the synthetic control and the treated countries. Appendix Table D.9 reports the optimal weights.

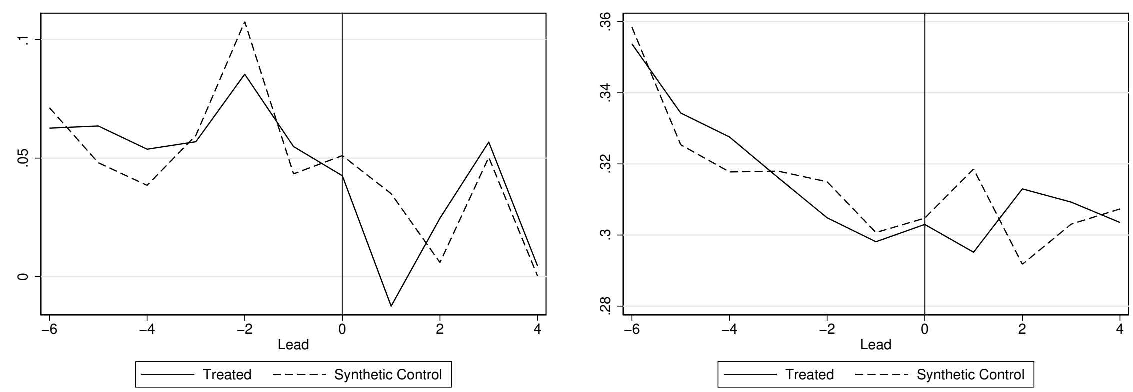
Figure 4 compares the average and dispersion of product quality between the synthetic control and the treated countries. The figure highlights two points. First, before the AFC the synthetic control and the treatment groups do not exhibit significant differences in any measures of product quality. Second, the impact of AFC is sharp and short-lived: after the decline in product quality in 1998, the affected economies quickly recovered, and by 1999 the impacts of AFC were no longer discernible. The rapid recovery in product quality was not a surprise, given that the financial markets in the crisis countries were only affected for a short period.

To draw statistical inferences, we conduct placebo simulations. Instead of comparing the

[16]The sample in Table 1 is subject to the same restriction but only contains 46 economies. The difference is due to data availability. Three economies, China, Taiwan, and the United Arab Emirates, have at least 50 products exported to the US and are, therefore, in the sample of the synthetic control exercises. However, they do not have valid data on the "Private Credit by Deposit Money Bank / GDP" ratio. Therefore, they are not in the sample of the regressions reported in Table 1. Please refer to Appendix Table D.1 for more details.

Figure 4: Synthetic Control Treatment Effects

(a) Mean (b) Standard Deviation



Notes: The figures summarize the treatment effects based on the synthetic control method. The matching variables include the per capita GDP, the (export + import)/GDP ratio, and the treatment variable itself: the mean or standard deviation of product quality growth in each panel. The treated group includes the Asian countries affected by the 1997 financial crisis, according to Laeven and Valencia (2018): China, Indonesia, Japan, Korea, Malaysia, Philippines, and Thailand. The time span is from 1991 to 2001. The vertical line at time 0 indicates the year 1997.

Table 2: Synthetic Control Treatment Effects, Asian Financial Crisis

	Mean		SD	
Year	coef.	p-val	coef.	p-val
1998	-0.0475^{***}	0.0000	-0.0234^{***}	0.0071
1999	0.0187	0.1307	0.0212^{*}	0.0537
2000	0.0064	0.4667	0.0062	0.4221
2001	0.0042	0.6413	-0.0038	0.4192

Notes: This table reports the treatment effects of AFC and their associated p-values on the mean and the standard deviation of product quality growth. ***: significant at the 1% level; *: significant at the 5% level; *: significant at the 10% level. The matching variables include the per capita GDP and the (export + import)/GDP ratio, and the treatment variable itself: the mean or standard deviation of product quality growth in each panel, respectively. The inference is based on 1,000,000 placebo averages. We exclude the placebo effects in the pool if the match quality measured as pre-treatment Root Mean Squared Predictive Error (RMSPE) is greater than five times the match quality of the treated unit.

treatment countries to synthetic control, a placebo simulation draws a random sample of countries from the control group; it then compares the variable of interest before and after the AFC to measure its impact in a placebo simulation. We conduct one million placebo simulations and then compare the estimated main effect — the difference between the treated and the synthetic control — to the distribution of placebo simulations to compute p-values.[17]

Table 2 reports the results. The Asian Financial Crisis significantly reduced both the average product quality and quality dispersion in the affected countries, and the effects were concentrated immediately after the financial shock in 1998. The magnitude of the impact is economically large. The average product quality drops by around 0.0475, which is around 1.07 standard deviations.[18] The AFC also lowered the dispersion of product quality in 1998: relative to the synthetic control, the standard deviation of product quality in countries affected by the AFC declined by 0.023, or 0.33 standard deviations. Similar to the message of Figure 4, the placebo simulations also confirm that the impacts of AFC were short-lived: starting from 1999, the effects are no longer significantly different from zero.

We explore the robustness of the above results in several dimensions and summarize the results in Appendix Table D.10. First, four Asian economies in the set of potential control countries, Hong Kong, Macau, Singapore, and Taiwan, were not considered to have suffered from a "systemic financial crisis" in 1997-1998 according to Laeven and Valencia (2018). While these economies were less affected by the AFC, one might worry that they drove our results. In row (1), we drop these countries from the control group and show that the results were unaffected. We also explore an extended set of matching variables in addition to the three used in the baseline results in row (2). Rows (3) to (5) report the robustness checks using different measures of match quality at the inference stage. In the baseline results, we exclude the placebo simulations if the match quality measured as pre-treatment RMSPE is greater than five times that of the synthetic control. We show that our results are robust if we use a lower or higher threshold or no threshold. Rows (6) to (9) report the robustness of the results to various data-cleaning procedures similar to those reported in Table D.6. Lastly, in Panel (b) of the same table, we show that the impact of the AFC also holds if we measure product quality using the median and dispersion using $\log(\sigma_{ct})$. Across these robustness checks, the impacts of AFC on average product quality are robust. The impacts on quality dispersion retain a similar magnitude, though the precision is lower.

[17] We exclude the placebo simulations with poor match quality from the pool for statistical inference. Specifically, we drop those whose pre-treatment Root Mean Squared Predictive Error (RMSPE) is greater than 5 times the match quality of the synthetic control. We show in robustness checks that this restriction does not drive our results.

[18] The standard deviation of μ_{ct} across 49 countries and 11 years is 0.043, and the impact response is $0.046/0.043 = 1.07$ standard deviations. Similarly, the standard deviation of σ_{ct} is 0.069. Therefore the impact of the AFC is $0.023/0.069 = 0.33$ standard deviation.

4 Conclusion

This paper studies the dynamics of product quality changes in US imports to explore the tradeoff between risk and return in quality improvements in the exporting countries. Across one decade, 1990-2001, the paper documents how the first two moments of quality growth vary across countries and products. Three stylized facts emerge from our analysis. First, there is a strong positive relationship between the mean and the variance of quality growth, consistent with a risk-return tradeoff. Second, developing countries occupy the less risky parts of the frontier. Finally, we find that the different positions that countries occupy along the risk-return frontier are explained by financial market depth, even conditional on per capita income.

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ONLINE APPENDIX
(NOT FOR PUBLICATION)

Appendix A Proof of Proposition 1

With some manipulation, under financial development ψ, the income of the firm's owner when the project succeeds can be written as:

$$\begin{aligned}\overline{y} &= \psi\left(\phi\overline{\pi}+(1-\phi)\underline{\pi}\right)+(1-\psi)\,\overline{\pi} \\ &= \left(\phi\overline{\pi}+(1-\phi)\underline{\pi}\right)+(1-\psi)\,(1-\phi)\,(\overline{\pi}-\underline{\pi})\,.\end{aligned}$$

Similarly, when the project fails, the income is:

$$\begin{aligned}\underline{y} &= \psi\left(\phi\overline{\pi}+(1-\phi)\underline{\pi}\right)+(1-\psi)\,\underline{\pi} \\ &= \left(\phi\overline{\pi}+(1-\phi)\underline{\pi}\right)-(1-\psi)\,\phi\,(\overline{\pi}-\underline{\pi})\,.\end{aligned}$$

The expected utility is thus:

$$\begin{aligned}E(u(y)) &= \phi u\left[\left(\phi\overline{\pi}+(1-\phi)\underline{\pi}\right)+(1-\psi)\,(1-\phi)\,(\overline{\pi}-\underline{\pi})\right] \\ &\quad +(1-\phi)u\left[\left(\phi\overline{\pi}+(1-\phi)\underline{\pi}\right)-(1-\psi)\,\phi\,(\overline{\pi}-\underline{\pi})\right].\end{aligned}$$

To determine whether the firm engages in risky quality upgrading, the firm's owner compares $E(u(y))$ with the utility from undertaking the riskless project $u(\pi_b)$. By A1, when $\psi=1$, $E(u(y))>u(\pi_b)$ and the risky quality upgrading project gets undertaken. By A2, when $\psi=0$, $E(u(y))<u(\pi_b)$, and the project does not get undertaken. By the Intermediate Value Theorem, if $\forall\psi\in[0,1]$ $\frac{dE(u(y))}{d\psi}>0$, then $\exists\widetilde{\psi}\in[0,1]$ such that $E(u(y))>u(\pi_b)$ $\forall\psi>\widetilde{\psi}$ and $E(u(y))<u(\pi_b)$ $\forall\psi<\widetilde{\psi}$. Thus, the risky quality upgrading gets undertaken when $\psi>\widetilde{\psi}$ and vice versa.

Direct algebra establishes that $\frac{dE(u(y))}{d\psi}>0$:

$$\begin{aligned}\frac{dE(u(y))}{d\psi} &= -\frac{dE(u(y))}{d\,(1-\psi)} \\ &= -\left[\phi u'(\overline{y})\,(1-\phi)\,(\overline{\pi}-\underline{\pi})-(1-\phi)u'(\underline{y})\phi\,(\overline{\pi}-\underline{\pi})\right] \\ &= -\phi\,(1-\phi)\,(\overline{\pi}-\underline{\pi})\left[u'(\overline{y})-u'(\underline{y})\right] \\ &= \phi\,(1-\phi)\,(\overline{\pi}-\underline{\pi})\left[u'(\underline{y})-u'(\overline{y})\right]>0\end{aligned}$$

for concave $u(.)$.

The claims about the mean and variance of price growth are proved in the main text.■

Appendix B Alternate Measure of Quality

Table D.4 shows that the results are robust to using Khandelwal (2010)'s measure of quality. Khandelwal (2010) argues that unobserved supply shocks can cause price differentials that do not correspond to differences in quality and hence a better measure of quality would be market share conditional on price: a higher price with little market share may well represent higher costs rather than quality. We follow his procedure for backing out these measures of quality. The quality of an imported variety is its relative market share after controlling for exporter size and price. Thus, a variety's quality will rise if its price can rise without losing market share.

This appendix presents a brief summary of the procedure; the reader is referred to Khandelwal (2010) for the details. Let t index years, h HS10 products, c variety coming from country c, and m a five-digit SITC industry. The estimation equation is:

$$ln(S_{cht}) - ln(S_{0t}) = \lambda_{1,ch} + \lambda_{2,t} + \alpha P_{cht} + \omega ln(ns_{cht}) + \gamma ln(pop)_{ct} + \lambda_{3,cht}. \qquad \text{B.1}$$

In (B.1), $ln(S_{0t})$ corresponds to 1 minus the industry's import penetration representing the outside variety. Import penetration is defined as $I_{mt}/(Q_{mt} + I_{mt} - X_{mt})$, where I_{mt} is the value of imports, Q_{mt} is the industry's domestic production, and X_{mt} represents the US exports. We can define $(Q_{mt} + I_{mt} - X_{mt})$ as the total industry output MKT_t. The variable S_{cht} denotes the imported variety's market share. This variable is calculated as the quotient of the import value of variety c and the total industry output, MKT_t, which corresponds to the sum of imports and domestic production minus exports. Let ns_{cht} denote c's market share within product h.

Quality is estimated by adding three components $\lambda_{1,ch} + \lambda_{2,t} + \lambda_{3,cht}$. $\lambda_{1,ch}$ is the time-invariant component of quality captured by variety fixed effects, $\lambda_{2,t}$ is the common quality component captured by year fixed effects, and $\lambda_{3,cht}$ is the estimation error. Since $\lambda_{3,cht}$ and ns_{cht} are potentially correlated with the variety's price, instrumental variables we use the same instrumental variables as Khandelwal (2010).[19] $ln(pop)_{ct}$ corresponds to the population of country c. As in Khandelwal (2010) we estimate the regression (B.1) on US product-level import data for each of the 1058 SITC industries and then capture the estimated quality.

The correlation between this measure and the unit value-based quality measure is roughly 0.4. Both are positively correlated with income as previous studies have found. It needs to be kept in mind that this procedure brings along its own set of issues. As pointed out by Khandelwal (2010), market shares may reflect more than just the price-quality combination.

[19]The instruments for prices are transportation costs, exchange rates, and the interaction of distance to the United States with oil prices. ns_{cht} is instrumented with the number of varieties within product h and the number of varieties exported by country c.

For example, the literature on trade networks (see e.g. Casella and Rauch, 2002) argues that prices alone are not adequate to explain trade flows (and hence market share) and hence the residual of regression like (B.1) is some combination of quality and factors such as networks. Rauch (1999) argues that for differentiated goods, exactly those used here, countries sharing a language or a colonial history have twice as much trade as those that don't, perhaps capturing network effects that resolve information or contracting problems. Arguably the impact of trade agreements is not purely through lower prices because it misses the vast networks of production chains and personal contacts that occur. This may explain, for instance, why, for instance, both Mexico and Canada show levels of quality far above any Scandinavian country and are close to the UK and Switzerland. Hence, both the raw unit values as well as Khandelwal (2010)'s quality measures may suffer to a certain degree from omitted variable bias. For related reasons, it may also be argued that while Khandelwal (2010)'s instruments are appropriate for the *levels* of prices, they are arguably less powerful for identifying the *changes* in quality that we seek to measure.

Appendix C Data

Stock Market Age We collect the establishment year of a country's first stock exchange mainly via the information provided on the stock exchange's official website. In the estimation sample behind Table 1, the oldest stock exchange is the Frankfurt Stock Exchange, established in 1585, with an age of 417 years by 2002. The youngest stock exchange is BHV in Honduras, established in 1993. The average age of the stock exchange by 2002 is 135 years. Two economies, Pakistan and Macau, do not have any stock exchange by 2002, so we assign a value of 0 to their stock market age.

We treat four former Eastern Bloc countries (Poland, Romania, Hungary, and Bulgaria) and China differently from the rest of the sample. These countries established their earliest stock market exchanges in the 19th or early 20th century but ceased operations from 1950 to 1990 under communist regimes. As a result, we used the re-opening dates of their stock market, mostly in 1990-1991, instead of the original date, to compute the age of their stock market.

Financial Crisis We use the financial crisis data compiled by Laeven and Valencia (2018). Out of the four measures of the financial crisis, we use the "systemic financial crisis" to classify the countries affected by the Asian Financial Crisis. To be precise, we classify all the East and Southeast Asian countries that experienced a systemic financial crisis in 1997 or 1998 as affected by the AFC.

Penn World Table We use the following variables from Penn World Table (version 10.0) as the matching variables in the synthetic control exercise: Expenditure-side real GDP (`rgdpna`), population (`pop`), the share of merchandise imports and exports (`csh_m` and `csh_x`), capital stock (`rnna`).

Appendix D Additional Tables

Table D.1: Country Sample

Argentina	Denmark	India	Netherlands	Sri Lanka
Australia	Dominican Rep.	Indonesia	Norway	Sweden
Austria	Egypt	Ireland	Pakistan	Switzerland
Bangladesh	El Salvador	Israel	Peru	Taiwan*
Belgium	Finland	Italy	Philippines	Thailand
Brazil	France	Japan	Poland	Turkey
Canada	Germany	Korea	Portugal	U.A.E*
China*	Guatemala	Macau	Singapore	United Kingdom
Colombia	Honduras	Malaysia	South Africa	Venezuela
Costa Rica	Hong Kong	Mexico	Spain	

Notes: This table lists the countries and regions used in the analysis. These are the 49 economies that exported 50 or more products to the US. The underlined economies are those affected by the Asian Financial Crisis. The names with "*" do not have measures of financial depth and are therefore missing in the analysis reported in Table 1.

Table D.2: Quality Mean Growth vs. Dispersion

	(1)	(2)	(3)	(4)	(5)
	> 50	> 100	> 500	Products	> 50 + PFE
Standard Deviation	0.676***	0.647***	1.190***	0.838***	0.706***
	(0.086)	(0.098)	(0.291)	(0.210)	(0.129)
Constant	-0.002	0.000	-0.043	-0.001	0.005***
	(0.006)	(0.008)	(0.024)	(0.010)	(0.001)
N	49	37	12	18	48
Adj. R-squared	0.557	0.541	0.587	0.410	0.419

Notes: Regressions of mean quality growth (percent change in unit values) on the standard deviation of that growth. Samples in columns (1), (2), (3): countries with greater than 50, 100, 500 products exported to the U.S. Column (4): product fixed effects. Column (5): country fixed effects for countries with greater than 50 products and netting out product fixed effects. Robust standard errors are in parentheses. ***: significant at the 1% level; *: significant at the 5% level; *: significant at the 10% level.

Table D.3: Decomposing the Sources of Variance

	Mean		SD	
Source	Partial SS	D.F.	Partial SS	D.F.
Model	0.327	66	0.190	66
Country	0.104	48	0.094	48
Sector	0.220	18	0.088	18
Residual	1.173	602	0.412	509
Total	1.500	668	0.602	575

Notes: This table reports the Analysis-of-Variance (ANOVA) results using the data at the country-SIC2 level. The sample is countries with at least 50 products exported to the US. "Sector" refers to an SIC2 industry. "Partial SS" is the partial sums of squares, and "D.F." is the degrees of freedom.

Table D.4: Quality Mean Growth vs. Dispersion: Alternate Measure of Quality

	(1)	(2)	(3)	(4)	(5)
	> 50	> 100	> 500	Products	> 50 + PFE
Standard Deviation	1.357***	1.298***	2.239**	1.359***	0.643***
	(0.254)	(0.359)	(0.697)	(0.384)	(0.216)
Constant	0.001	0.003	-0.096	-0.067**	0.013***
	(0.027)	(0.038)	(0.073)	(0.025)	(0.004)
N	34	25	11	17	33
Adj. R-squared	0.456	0.335	0.482	0.384	0.119

Notes: Regressions of mean quality growth (percent change in unit values; Khandelwal approach) on the standard deviation of that growth. Samples in columns (1), (2), (3): countries with greater than 50, 100, 500 products exported to the U.S. Column (4): product fixed effects. Column (5): country fixed effects for countries with greater than 50 products and netting out product fixed effects. Robust standard errors are in parentheses. ***: significant at the 1% level; *: significant at the 5% level; *: significant at the 10% level.

Table D.5: Robustness: Alternative Measure of Financial Depth

(a) Deposit Money Bank Assets/ GDP, Mean and SD

	Mean				SD			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	2SLS	2SLS	2SLS	OLS	2SLS	2SLS	2SLS
Financial Variable	0.014***	0.038***	0.031***	0.026**	0.007*	0.041***	0.037***	0.024**
	(0.003)	(0.007)	(0.005)	(0.010)	(0.004)	(0.007)	(0.006)	(0.010)
Off-shore	-0.018***		-0.021***	-0.020***	-0.008**		-0.013***	-0.012**
	(0.003)		(0.003)	(0.003)	(0.004)		(0.005)	(0.005)
Ln(GDP per capita)	0.004***			0.002	0.008***			0.005*
	(0.001)			(0.002)	(0.002)			(0.003)
Constant	0.001	0.019***	0.028***	0.015	-0.002	0.042***	0.048***	0.017
	(0.008)	(0.006)	(0.004)	(0.013)	(0.012)	(0.006)	(0.004)	(0.017)
N	46	46	46	46	46	46	46	46
First Stage F-Stat		48.579	60.619	16.754		48.579	60.619	16.754

(b) Deposit Money Bank Assets/ GDP, Median and log(SD)

	Median				log(SD)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	2SLS	2SLS	2SLS	OLS	2SLS	2SLS	2SLS
Financial Variable	0.014***	0.029***	0.023***	0.027**	0.007*	0.574***	0.515***	0.300**
	(0.004)	(0.008)	(0.006)	(0.013)	(0.004)	(0.102)	(0.083)	(0.140)
Off-shore	-0.017***		-0.019***	-0.020***	-0.008**		-0.185***	-0.157**
	(0.003)		(0.004)	(0.004)	(0.004)		(0.072)	(0.070)
Ln(GDP per capita)	0.001			-0.002	0.008***			0.074*
	(0.001)			(0.003)	(0.002)			(0.039)
Constant	0.015	0.010	0.019***	0.029*	-0.002	-3.075***	-2.994***	-3.492***
	(0.010)	(0.006)	(0.004)	(0.016)	(0.012)	(0.085)	(0.066)	(0.260)
N	46	46	46	46	46	46	46	46
First Stage F-Stat		48.579	60.619	16.754		48.579	60.619	16.754

Notes: This table reports the results of estimating equation (5). "Financial Variable" refers to the "Deposit Money Bank Assets/GDP" ratio. Robust standard errors are in parentheses. ***: significant at the 1% level; *: significant at the 5% level; *: significant at the 10% level. The sample is countries with at least 50 products exported to the US. Locales captured by off-shore dummy==1 are Macao, Singapore, Costa Rica, Dominican Republic, Malaysia, Hong Kong, Luxembourg, Switzerland, and South Africa. The instrument variable for the financial depth variable is the age of a country's oldest stock exchange as of 2002.

Table D.6: Robustness: Financial Depth and Product Quality

(a) Median and log(SD)

	Median				log(SD)			
	(1) OLS	(2) 2SLS	(3) 2SLS	(4) 2SLS	(5) OLS	(6) 2SLS	(7) 2SLS	(8) 2SLS
Financial Variable	0.016***	0.033***	0.026***	0.035**	0.004	0.662***	0.589***	0.385*
	(0.005)	(0.009)	(0.007)	(0.017)	(0.004)	(0.129)	(0.105)	(0.199)
Off-shore	-0.018***		-0.020***	-0.021***	-0.008*		-0.199**	-0.171**
	(0.004)		(0.004)	(0.005)	(0.004)		(0.084)	(0.084)
Ln(GDP per capita)	0.001			-0.003	0.009***			0.062
	(0.001)			(0.003)	(0.002)			(0.047)
Constant	0.017	0.011*	0.020***	0.038*	-0.005	-3.062***	-2.977***	-3.396***
	(0.010)	(0.006)	(0.004)	(0.020)	(0.012)	(0.092)	(0.070)	(0.313)
N	46	46	46	46	46	46	46	46
First Stage F-Stat		40.453	46.697	11.474		40.453	46.697	11.474

(b) Varying Countries and Controls

	Mean				SD			
	(1) -Country	(2) -Country	(3) +Control	(4) +Control	(5) -Country	(6) -Country	(7) +Control	(8) +Control
Financial Variable	0.033**	0.027**	0.034***	0.031**	0.031**	0.023**	0.036***	0.022
	(0.013)	(0.011)	(0.006)	(0.014)	(0.014)	(0.011)	(0.008)	(0.014)
Off-shore	-0.021***	-0.020***	-0.020***	-0.020***	-0.012**	-0.008**	-0.010	-0.008
	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)	(0.003)	(0.006)	(0.006)
Ln(GDP per capita)	0.001	0.002		0.001	0.004	0.005**		0.004
	(0.003)	(0.002)		(0.003)	(0.003)	(0.003)		(0.003)
Ln(GDP)			0.000	0.000			0.002	0.003*
			(0.001)	(0.001)			(0.002)	(0.001)
(Exp+Imp)/GDP			0.013	0.011			0.023	0.011
			(0.013)	(0.014)			(0.027)	(0.020)
Constant	0.023	0.017	0.025	0.017	0.024	0.014	0.024	-0.011
	(0.015)	(0.014)	(0.017)	(0.030)	(0.020)	(0.018)	(0.018)	(0.029)
N	44	42	46	46	44	42	46	46
First Stage F-Stat	12.125	12.910	28.278	7.956	12.125	12.910	28.278	7.956

(c) Varying Data Cleaning Procedures

	Mean				SD			
	(1) IM.>5000	(2) IM.>10000	(3) $\dot{u}_{ict} \leq 3$	(4) $\dot{u}_{ict} \leq 10$	(5) IM.>5000	(6) IM.>10000	(7) $\dot{u}_{ict} \leq 3$	(8) $\dot{u}_{ict} \leq 10$
Financial Variable	0.028**	0.037***	0.051**	0.201***	0.026**	0.034**	0.042**	0.183**
	(0.014)	(0.014)	(0.020)	(0.075)	(0.012)	(0.015)	(0.020)	(0.092)
Off-shore	-0.020***	-0.020***	-0.029***	-0.087***	-0.011**	-0.012**	-0.019**	-0.080**
	(0.004)	(0.004)	(0.007)	(0.028)	(0.005)	(0.006)	(0.009)	(0.036)
Ln(GDP per capita)	0.001	-0.000	0.003	0.006	0.004	0.003	0.006	0.019
	(0.003)	(0.003)	(0.004)	(0.016)	(0.003)	(0.003)	(0.005)	(0.021)
Constant	0.025	0.029*	0.011	-0.024	0.027	0.029	0.016	-0.056
	(0.015)	(0.015)	(0.025)	(0.097)	(0.018)	(0.021)	(0.031)	(0.137)
N	47	46	47	50	47	46	47	50
First Stage F-Stat	13.076	11.474	13.076	12.011	13.076	11.474	13.076	12.011

Notes: The tables report robustness checks of estimating equation (5). Panel (a) reports the results using the median growth and the log of the standard deviation of product quality. Panel (b) reports the results using different samples and control variables. Columns (1) and (5) drop Singapore and Hong Kong from the baseline sample. Columns (2) and (6) further drop Macao and Luxembourg. Columns (3) and (7) replace per capita GDP with GDP and control the trade-to-GDP ratio. Columns (4) and (8) control per capita, total GDP, and the trade-to-GDP ratio. Panel (c) reports the results using various data cleaning procedures. Columns (1), (2), (5), and (6) report the results if we include all the country-HS10-year cells with more than \$5,000 or \$10,000 in the data. (In the baseline, we include all the cells with more than \$7,500.) Columns (3), (4), (7), and (8) report the results of different data trimming thresholds by dropping all the outliers with $\dot{u}_{ict} > 3$ or $\dot{u}_{ict} > 10$. In the baseline, we drop all the $\dot{u}_{ict} > 2$. The observations are at the country level. Robust standard errors are in parentheses. ***: significant at the 1% level; *: significant at the 5% level; *: significant at the 10% level. The instrument for the financial variable is the age of a country's oldest stock exchange as of 2002.

Table D.7: Robustness: Financial Depth and Product Quality at the Country-Industry Level

(a) Private Credit by Deposit Money Banks/ GDP

	Mean				SD			
	(1) OLS	(2) 2SLS	(3) 2SLS	(4) 2SLS	(5) OLS	(6) 2SLS	(7) 2SLS	(8) 2SLS
Financial Variable	0.011**	0.039***	0.035***	0.036**	0.242***	0.036***	0.032***	0.039***
	(0.005)	(0.010)	(0.008)	(0.016)	(0.090)	(0.007)	(0.006)	(0.012)
Off-shore	-0.007		-0.014***	-0.015**	-0.249***		-0.015***	-0.016***
	(0.004)		(0.005)	(0.006)	(0.063)		(0.004)	(0.006)
Ln(GDP per capita)	0.005***			-0.000	0.054*			-0.003
	(0.002)			(0.003)	(0.031)			(0.002)
Constant	0.008				-3.644***			
	(0.012)				(0.245)			
N	3,971	3,974	3,974	3,971	2,366	2,368	2,368	2,366
Fixed Effects	sic	sic	sic	sic	sic	sic	sic	sic
First Stage F-Stat		28.219	33.287	10.244		23.202	26.743	9.810

(b) Deposit Money Bank Assets/ GDP

	Mean				SD			
	(1) OLS	(2) 2SLS	(3) 2SLS	(4) 2SLS	(5) OLS	(6) 2SLS	(7) 2SLS	(8) 2SLS
Financial Variable	0.012***	0.035***	0.032***	0.030**	0.282***	0.032***	0.028***	0.033***
	(0.004)	(0.010)	(0.008)	(0.015)	(0.084)	(0.006)	(0.005)	(0.010)
Off-shore	-0.008*		-0.014***	-0.014**	-0.268***		-0.015***	-0.015***
	(0.004)		(0.005)	(0.006)	(0.055)		(0.003)	(0.004)
Ln(GDP per capita)	0.005***			0.001	0.042			-0.002
	(0.001)			(0.003)	(0.032)			(0.002)
Constant	0.008				-3.610***			
	(0.012)				(0.244)			
N	3,971	3,974	3,974	3,971	2,366	2,368	2,368	2,366
Fixed Effects	sic	sic	sic	sic	sic	sic	sic	sic
First Stage F-Stat		48.635	61.246	12.753		43.713	50.922	11.229

Notes: This table reports the results of estimating equation (6). “Financial Variable” refers to the “Private Credit by Deposit Money Banks/GDP” ratio in Panel (a), and “Deposit Money Bank Assets/GDP” in Panel(b). Observations at the country-SIC4 level. Standard errors clustered at the country level. ***: significant at the 1% level; *: significant at the 5% level; *: significant at the 10% level. The sample is countries with at least 50 products exported to the US. The instrument variable for the financial variable is the age of a country’s oldest stock exchange as of 2002.

Table D.8: Robustness: Financial Depth and Product Quality at the Country-Industry Level, Median and log(SD) at the Country-Industry Level

(a) Private Credit by Deposit Money Banks/ GDP

	Median				log(SD)			
	(1) OLS	(2) 2SLS	(3) 2SLS	(4) 2SLS	(5) OLS	(6) 2SLS	(7) 2SLS	(8) 2SLS
Financial Variable	0.009*	0.034***	0.031***	0.031*	0.008**	0.706***	0.605***	0.726***
	(0.005)	(0.009)	(0.008)	(0.017)	(0.004)	(0.149)	(0.117)	(0.236)
Off-shore	-0.005		-0.012**	-0.012*	-0.007**		-0.372***	-0.397***
	(0.005)		(0.005)	(0.006)	(0.003)		(0.075)	(0.093)
Ln(GDP per capita)	0.005***			-0.000	0.004***			-0.048
	(0.002)			(0.004)	(0.001)			(0.053)
Constant	0.010				0.027***			
	(0.013)				(0.010)			
N	3,971	3,974	3,974	3,971	2,366	2,368	2,368	2,366
Fixed Effects	sic	sic	sic	sic	sic	sic	sic	sic
First Stage F-Stat		28.219	33.287	10.244		23.202	26.743	9.810

(b) Deposit Money Bank Assets/ GDP

	Median				log(SD)			
	(1) OLS	(2) 2SLS	(3) 2SLS	(4) 2SLS	(5) OLS	(6) 2SLS	(7) 2SLS	(8) 2SLS
Financial Variable	0.009**	0.031***	0.028***	0.026*	0.010***	0.631***	0.543***	0.611***
	(0.004)	(0.010)	(0.008)	(0.015)	(0.003)	(0.129)	(0.102)	(0.194)
Off-shore	-0.006		-0.012**	-0.011*	-0.008***		-0.363***	-0.377***
	(0.004)		(0.005)	(0.006)	(0.002)		(0.063)	(0.076)
Ln(GDP per capita)	0.004***			0.001	0.003**			-0.030
	(0.002)			(0.003)	(0.001)			(0.049)
Constant	0.009				0.029***			
	(0.012)				(0.010)			
N	3,971	3,974	3,974	3,971	2,366	2,368	2,368	2,366
Fixed Effects	sic	sic	sic	sic	sic	sic	sic	sic
First Stage F-Stat		48.635	61.246	12.753		43.713	50.922	11.229

Notes: This table reports the results of estimating equation (6). The "financial variable" refers to the "Private Credit by Deposit Money Banks/GDP" ratio in Panel (a), and "Deposit Money Bank Assets/GDP" in Panel(b). Observations at the country-SIC4 level. Standard errors clustered at the country level. ***: significant at the 1% level; *: significant at the 5% level; *: significant at the 10% level. The sample is countries with at least 50 products exported to the US. The instrument variable for the financial variable is the age of a country's oldest stock exchange as of 2002.

Table D.9: Optimal Weights, Synthetic Control

	China		Indonesia		Japan		Korea		Malaysia		Philippines		Thailand	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Argentina	0.249	0.007	0.145	0.005	0.004	0.007	0.013	0.017	0.006	0.008	0.108	0.010	0.014	0.015
Australia	0.000	0.006	0.003	0.003	0.578	0.026	0.016	0.015	0.007	0.005	0.006	0.008	0.012	0.011
Austria	0.000	0.004	0.002	0.004	0.000	0.012	0.019	0.016	0.015	0.007	0.004	0.007	0.015	0.014
Bangladesh	0.000	0.004	0.077	0.372	0.000	0.003	0.012	0.022	0.012	0.135	0.115	0.130	0.054	0.126
Belgium	0.000	0.005	0.002	0.004	0.000	0.012	0.020	0.017	0.014	0.008	0.004	0.008	0.014	0.014
Brazil	0.000	0.006	0.005	0.007	0.000	0.006	0.015	0.019	0.011	0.011	0.010	0.013	0.019	0.019
Canada	0.000	0.005	0.002	0.005	0.000	0.015	0.035	0.019	0.023	0.009	0.003	0.010	0.015	0.014
Colombia	0.000	0.006	0.004	0.008	0.000	0.006	0.017	0.019	0.014	0.012	0.008	0.013	0.021	0.020
Costa Rica	0.000	0.004	0.001	0.006	0.000	0.005	0.022	0.020	0.026	0.022	0.005	0.010	0.024	0.028
Denmark	0.000	0.007	0.003	0.003	0.001	0.025	0.020	0.015	0.011	0.005	0.005	0.008	0.013	0.011
Dominican Rep.	0.000	0.004	0.001	0.007	0.000	0.004	0.025	0.021	0.188	0.034	0.005	0.012	0.053	0.038
Egypt	0.000	0.006	0.005	0.008	0.000	0.004	0.013	0.018	0.012	0.015	0.018	0.014	0.026	0.027
El Salvador	0.000	0.005	0.001	0.005	0.000	0.004	0.010	0.014	0.012	0.009	0.172	0.254	0.072	0.060
Finland	0.000	0.006	0.002	0.006	0.000	0.011	0.036	0.019	0.021	0.009	0.004	0.011	0.016	0.015
France	0.000	0.006	0.002	0.003	0.001	0.018	0.019	0.015	0.012	0.005	0.005	0.007	0.014	0.011
Germany	0.000	0.005	0.002	0.004	0.001	0.016	0.019	0.016	0.012	0.006	0.005	0.008	0.014	0.012
Guatemala	0.000	0.006	0.004	0.008	0.000	0.005	0.013	0.018	0.011	0.013	0.018	0.012	0.024	0.023
Honduras	0.000	0.004	0.001	0.031	0.000	0.004	0.016	0.023	0.034	0.169	0.007	0.024	0.132	0.100
Hong Kong	0.000	0.006	0.003	0.006	0.000	0.016	0.027	0.020	0.015	0.008	0.004	0.012	0.014	0.014
India	0.682	0.658	0.489	0.051	0.000	0.004	0.013	0.016	0.012	0.009	0.040	0.105	0.050	0.018
Ireland	0.000	0.009	0.008	0.005	0.000	0.010	0.024	0.018	0.012	0.006	0.005	0.013	0.014	0.012
Israel	0.000	0.004	0.001	0.004	0.000	0.010	0.018	0.017	0.015	0.010	0.004	0.007	0.015	0.017
Italy	0.000	0.006	0.003	0.003	0.001	0.020	0.020	0.015	0.012	0.005	0.005	0.008	0.014	0.011
Macau	0.000	0.003	0.001	0.004	0.000	0.009	0.061	0.001	0.037	0.024	0.003	0.005	0.016	0.025
Mexico	0.000	0.006	0.002	0.006	0.000	0.007	0.021	0.017	0.019	0.009	0.005	0.010	0.020	0.016
Netherlands	0.000	0.006	0.003	0.004	0.001	0.019	0.020	0.016	0.011	0.006	0.005	0.008	0.013	0.011
Norway	0.069	0.010	0.158	0.006	0.193	0.252	0.033	0.020	0.013	0.006	0.004	0.017	0.014	0.012
Pakistan	0.000	0.012	0.010	0.011	0.000	0.004	0.014	0.019	0.013	0.014	0.015	0.021	0.033	0.025
Peru	0.000	0.006	0.024	0.009	0.000	0.004	0.012	0.020	0.008	0.018	0.334	0.016	0.020	0.028
Poland	0.000	0.004	0.003	0.007	0.000	0.005	0.017	0.022	0.013	0.024	0.007	0.010	0.019	0.028
Portugal	0.000	0.004	0.002	0.005	0.000	0.008	0.014	0.017	0.009	0.010	0.007	0.007	0.014	0.017
Singapore	0.000	0.002	0.000	0.003	0.000	0.007	0.015	0.014	0.049	0.044	0.003	0.002	0.018	0.026
South Africa	0.000	0.005	0.001	0.009	0.000	0.005	0.068	0.023	0.188	0.018	0.004	0.014	0.025	0.024
Spain	0.000	0.005	0.002	0.005	0.000	0.009	0.021	0.017	0.018	0.009	0.004	0.008	0.017	0.015
Sri Lanka	0.000	0.006	0.008	0.011	0.000	0.004	0.014	0.021	0.012	0.021	0.017	0.019	0.025	0.032
Sweden	0.000	0.006	0.003	0.004	0.001	0.015	0.020	0.017	0.011	0.007	0.005	0.009	0.013	0.013
Switzerland	0.000	0.005	0.002	0.003	0.212	0.215	0.017	0.015	0.008	0.005	0.005	0.007	0.011	0.011
Taiwan	0.000	0.005	0.002	0.006	0.000	0.010	0.024	0.021	0.016	0.011	0.004	0.010	0.015	0.017
Turkey	0.000	0.005	0.002	0.006	0.000	0.006	0.020	0.018	0.018	0.010	0.005	0.010	0.020	0.018
U.A.E	0.000	0.003	0.001	0.004	0.001	0.145	0.121	0.228	0.024	0.219	0.002	0.004	0.012	0.020
United Kingdom	0.000	0.006	0.002	0.003	0.001	0.031	0.015	0.014	0.007	0.005	0.006	0.006	0.012	0.011
Venezuela	0.000	0.121	0.006	0.336	0.000	0.005	0.033	0.072	0.019	0.018	0.005	0.116	0.022	0.023

Notes: This table reports the optimal weights used in constructing the synthetic control for the 7 countries affected by the Asian Financial Crisis: China, Indonesia, Japan, Korea, Malaysia, Philippines, and Thailand. For each country, we report the weights separately for the two treated variables: the mean or the standard deviation of product quality growth. Each column adds up to 1.

Table D.10: Robustness Checks, Synthetic Control

(a) Mean and SD

	Mean		SD	
Robustness Checks	coef.	p-val	coef.	p-val
(1) Droping other Asian economies	-0.0488^{***}	0.0000	-0.0218^{**}	0.0209
(2) Additional matching variables	-0.0537^{***}	0.0000	-0.0189	0.1022
(3) RMSPE limit = 3	-0.0475^{***}	0.0000	-0.0234^{**}	0.0165
(4) RMSPE limit = 10	-0.0475^{***}	0.0000	-0.0234^{***}	0.0070
(5) No RMSPE limit	-0.0475^{***}	0.0000	-0.0234^{***}	0.0069
(6) Imports > USD 5,000	-0.0478^{***}	0.0000	-0.0239^{*}	0.0599
(7) Imports > USD 10,000	-0.0442^{***}	0.0000	-0.0161^{*}	0.0738
(8) $\dot{u}_{ict} \leq 3$	-0.0653^{***}	0.0000	-0.0617^{***}	0.0005
(9) $\dot{u}_{ict} \leq 10$	-0.0817^{***}	0.0000	-0.1087^{*}	0.0858

(b) Median and log(SD)

	Median		log(SD)	
Year	coef.	p-val	coef.	p-val
1998	-0.0431^{***}	0.0000	-0.0775^{**}	0.0192
1999	0.0137	0.3801	0.0766^{**}	0.0482
2000	0.0171	0.1314	0.0185	0.3866
2001	-0.0049	0.5818	-0.0062	0.5500

Notes: This table reports the robustness checks related to the synthetic control exercise. Panel (a) reports the results using mean and SD. Row (1) drops four Asian economies from the control group: Hong Kong, Macau, Singapore, and Taiwan. Row (2) adds two more matching variables: population and capital stock. Rows (3) to (5) report the treatment effects under various RMSPE limits. In the baseline specification, we exclude the placebo effects in the pool if the match quality measured as pre-treatment Root Mean Squared Predictive Error (RMSPE) is greater than 5 times the match quality of the synthetic control. These rows report the results if we exclude the simulations with RMSPE greater than 3 or 10 times the match quality or impose no such limit (Row 5). Changing the RMSPE limit only affects the p-values, not the coefficients. Rows (6) and (7) report the results if we include all the country-HS10-year cells with more than \$5,000 or \$10,000 in the data. In the baseline, we include all the cells with more than \$7,500. Rows (8) and (9) report the results of different data trimming thresholds by dropping all the outliers with $\dot{u}_{ict} > 3$ or $\dot{u}_{ict} > 10$. In the baseline, we drop all the $\dot{u}_{ict} > 2$. Panel (b) reports the baseline results using the median and log(SD) instead of mean and SD.