Repercussions and determinants of export quality: evidence from China

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THESIS

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Repercussions and Determinants of Export Quality : Evidence from China

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Foreword

Exploring the determinants that help to solve the problem of poor export quality, especially for developing countries, triggers my interest. I attempt to uncover this problem by giving the research efforts from three sides.

The first one is to investigate the impact of related policy on the export quality. Incentive policies are accustomed to being used for the desired goals by governments, especially in developing countries. The improvement of export quality is no exception. Literature gives focuses on the impact of policies on the upgrading of export quality, such as polices related to subsidies, trade liberalization and foreign investment. Recently, the “Aid for Trade” policy is considered an additional tool to boost the export quality of recipients. But the little empirical evidence is provided, supporting the positive role of “Aid for Trade” policy on the export quality. Therefore, I would like to empirically clarify the relationship between the acceptation of “Aid for Trade” and the export quality of recipients by exploring the country-level panel data available from OECD Aid for Trade database.

Another problem related to the improvement of export quality is how to verify the export quality of differentiated products. Under the information asymmetry, the price is ineffective to be as the quality signal. Even if international buyers are willing to pay the higher price, it is uncertain that they will get the products of higher quality, the adverse selection induced by which will further dampen the activeness of firms producing high-quality products, and subsequently result in the emergence of "bad money drives out good" in the market. Hence, the failure of quality screening discourages firms to improve their export quality. Given that, the exploration of the effective verification mechanism of export quality is an indispensable part of this thesis. Intermediaries are documented theoretically to alleviate quality problems thanks to their investment in inspection technology or incentives to protect their reputation as quality sellers (Biglaiser and Friedman, 1994; Dasgupta and Mondria, 2012). This quality-verification hypothesis suggests a greater prevalence of trade intermediaries in the exports of goods that are more differentiated. However, when the complete contracts are not possible, trade intermediaries could be prone to delays. These two opposing views mirror the contrasting empirical results on the relationship between vertical product differentiation and the prevalence of trade intermediation. The inconclusiveness from the quality-verification hypothesis puzzles to me. Whether the controversy of quality-verification hypothesis is attributed to the neglect of trade intermediaries’ heterogeneity? To clarify this, my cooperator and I attempt to distinguish the specialized-intermediaries from the generalized type, following the theoretical ideal of Dasgupta and Mondria (2012) that intermediaries help to overcome the information cost due to the quality uncertainty by their specialized technology in the specifically narrow fields. Statistically, we identify the specialized-intermediary based on the concentration of intermediaries' export variety, which is measured by the Herfindahl index of the firm-level distribution of export sales over products conditional on the effect of ownership and size in a regression framework. The distinction of heterogeneous intermediaries appears promising to reconcile the contrasting results of the quality screening hypnosis by intermediaries. The finding of this part shows that specialized intermediaries are more prevalent in products with greater quality dispersion among local exporters, and export goods of higher quality than do generalized intermediaries. As specialized intermediaries account for only a minority of intermediated trade, it is unsurprising that their quality-verification role is masked in aggregate data. The contrasting finding of quality-screening for traders in Hong Kong is consistent with a greater proportion of these intermediaries being specialized (Feenstra and Hanson, 2004).

The first two studies focus on how governments and intermediaries help to improve the export quality. But how the firm's export behavior impact their export quality is inconclusive so far. In theory, firms benefit from "learning effect" through export. The participation of export encourages firms to increase efforts on innovation for the improvement of product quality and differentiation, so as to gain the market share in the more competitive market internationally. However, there is little empirically consensus on how the innovation behavior of firms is when their sales are primarily oriented towards international markets. Intuitively, take China, for example, export firms have a higher level of productivity and R&D investment than non-exporters (the processing trade is not considered here). But along with the boost of exports size and the increase of export intensity promoted by the export orientation strategy in China, the amount of R&D investment remains not increasing or even reduces for most exporters. It is confused me that why does a stark contrast stand between the activeness to be an export-orientated firm but passiveness to be an innovator (or just an R&D investor)? Does it require a higher level of productivity for firms to engage in innovation than to participate in the export activity? The inconclusiveness of the "export-innovation" nexus motivates my interest to make clear the impact of export orientation on firms' innovation behavior. Thanks to the exhaustive firm-level panel data in China, I confirm a robust negative association between the ex-ante market choice of export orientation and the subsequent R&D investment by exporters. To exploring the reason for this, I follow the idea of Aghion et al. (2018) which explains the phenomenon of exporters' reduction under the positive export shock from the perspective of the demand side. I differ them by confirming the impact of demand uncertainty effect, instead of competition effect in the international market, on the negative relationship export orientation and innovation efforts of firms. The measurement of demand uncertainty in the destination country is inspired by Fernandes and Tang (2014) who replies on the cultural diversity measuring the differentiation of demand preference between exporting and destination countries; by Crozet and

Koenig (2009) which adopts the country risk indices issued by ICRG reflecting the insecurity of destination countries; and by EIU which establish a “Country Risk Model” based partially on measuring the dispersion of economic performance.

Different from the argument focusing on the presence of processing trade firms, the finding in this part provides a new perspective, explaining why the deeper participation of export is not accompanied by the increase in innovation activeness for Chinese exporters.

In sum, this thesis, being composed of three chapters related to the export quality, gives answers of how the determinants from three sides impact on the export quality based on the empirical studies exploring the data of country-level, sector-level and firm-level, respectively. In the end, the topic of export quality is a difficult but truly fascinating one. I hope the reader will enjoy the rest of the thesis.

Résumé de la thèse

Cette thèse se compose de trois chapitres ayant en commun la question de la qualité des exportations dans un contexte de pays en voie de développement. La thèse s'intéresse plus particulièrement à différents aspects permettant d'améliorer le niveau de qualité des exportations. La thèse porte sur trois questions précises: (1) La politique d'aide au commerce joue-t-elle un rôle positif dans l'amélioration de la qualité des exportations ? (2) Dans le cas où les problèmes de qualité perdurent, quel est le rôle des intermédiaires ? Jouent-ils un rôle de vérification qui contribue à qualité des produits d'exportation ? (3) Plus généralement, comment les exportations affectent-elles le comportement d'innovation des entreprises ?

Chapitre 1 : Aide au commerce et qualité des exportations

Le premier chapitre est consacré à l'étude de politiques permettant l'amélioration de la qualité des exportations. Les gouvernements, des pays en voie de développement comme des pays riches, recourent à grands nombres de politiques d'incitation pour atteindre les objectifs économiques. L'amélioration de la qualité des exportations ne fait pas exception. La littérature existante a ainsi mis en évidence l'effet de montée en qualité des exportations permis par les subventions, la libéralisation du commerce et l'arrivée d'investissements étrangers. Peu d'attention a été porté à la politique d'"Aide au commerce" fournie par les pays riches aux pays en développement alors qu'elle est susceptible d'améliorer la qualité des exportations des bénéficiaires. La contribution du premier chapitre est d'établir empiriquement la relation entre la réception de l'"Aide au commerce" et la qualité des exportations des bénéficiaires en exploitant un panel de pays en voie de développement. L'aide au commerce reçue est extraite de la base de données de l'OCDE sur l'Aide au commerce.

Malgré le rôle central de l'aide au commerce (AauC) dans l'aide internationale au développement, son impact n'a été évalué que récemment en mettant l'accent sur son efficacité à promouvoir la valeur commerciale des bénéficiaires (Cali et te Velde 2011 ; Helble, Mann et Wilson 2012 ; Pettersson et Johansson 2013 ; Vijil et Wagner 2012). Ce chapitre examine au contraire les effets de l'aide au commerce sous un angle nouveau, en étudiant si et comment l'aide au commerce affecte la qualité des exportations des pays bénéficiaires et donc leur position dans l'échelle mondiale de la qualité.

Le prix du produit (ou sa valeur unitaire) est un indicateur largement utilisé pour évaluer la qualité du produit. Le principal problème avec le prix comme mesure de la qualité est qu'il

reflète non seulement la qualité, mais aussi la marge bénéficiaire et la productivité des entreprises. Pour isoler la " vraie " composante qualité des prix des produits, nous adoptons une approche d'estimation pour les produits différenciés largement utilisée dans la littérature empirique en organisation industrielle (Anderson, de Palma et Thisse, 1988 ; Anderson, de Palma et Thisse, 1992). Plus précisément, nous estimons la qualité à l'exportation des produits selon la méthode développée par Khandelwal (2010) et Khandelwal, Schott et Wei (2013).

Ce chapitre utilise le modèle de gravité pour examiner l'effet qualité de l'aide au commerce. Les résultats montrent que le montant total d'aide au commerce octroyés dans les domaines largement définis de la politique commerciale a un effet positif sur la qualité des exportations. L'effet augmente lorsque l'aide au commerce est cumulée dans le temps, ce qui implique qu'il faut du temps pour que l'impact entre pleinement en vigueur. L'effet de qualité est le plus perceptible pour l'aide au commerce fournie au titre de l'appui à la politique commerciale : une augmentation de 50 % de la valeur de l'aide au commerce reçue dans cette catégorie est associée à une augmentation de 0,5 à 1 % de la qualité des exportations vers les donateurs et autres pays de l'OCDE. La moitié de cet effet qualité est due à l'amélioration de la qualité des produits sur les marchés où les exportations sont continues (marge intensive), le reste étant dû à l'amélioration de la qualité des nouveaux produits sur les marchés déjà couverts et des produits existants sur les nouveaux marchés (marge extensive). En outre, l'aide au commerce au titre de l'appui à la politique commerciale obtenus d'autres donateurs de l'OCDE a également un impact positif et statistiquement significatif sur la qualité des produits vers un pays donné, surtout si l'on tient compte des délais, ce qui indique qu'il peut exister une certaine externalité entre les marchés donateurs et non donateurs pour l'effet qualité de l'aide au commerce. En moyenne, l'aide au commerce effectivement reçue au titre de l'assistance en matière de politique commerciale se traduit par une augmentation de 2% du niveau de qualité des exportations issues du pays bénéficiaire mesurée sur l'échelle de qualité de l'ensemble des pays en développement.

La contribution de cette recherche est double. Premièrement, notre recherche ajoute un nouvel aspect - c'est-à-dire la qualité des exportations - à la littérature récente sur l'évaluation de l'efficacité de l'aide au commerce, où l'aide au commerce a un impact positif mais limité sur la valeur commerciale (Cali et te Velde 2011 ; Helble, Mann et Wilson 2012 ; Pettersson et Johansson 2013 ; Vijil et Wagner 2012). Alors que les fonds d'aide au commerce visent spécifiquement à renforcer la capacité d'offre des pays bénéficiaires en vue d'une intégration plus poussée dans l'économie mondiale (OCDE/OMC 2007), l'expansion des chaînes de valeur mondiales pose un nouveau problème pour l'efficacité de l'aide au commerce : en réponse à la fragmentation croissante de la production transfrontalière, cette aide est désormais axée sur la nécessité de renforcer l'avantage comparatif du pays bénéficiant d'une aide dans ce secteur en fournissant des produits et services au coût et avec la qualité qui sont internationalement compétitifs (Lammersen et Roberts 2015, OCDE/WTO 2013). Dans cette optique, nous évaluons l'impact de l'aide au commerce sur la qualité des exportations des bénéficiaires, en distinguant les effets des différentes composantes de l'aide au commerce et en étudiant les effets sur différents marchés d'exportation. Deuxièmement, nous examinons l'évolution dans le temps des effets de l'aide au commerce sur la qualité et examinons les marges intensives et extensives en matiè_re de pays de destination et de produits. Un examen attentif de la dynamique du marché et des produits fournit des informations utiles sur les sources des effets observés, permettant une meilleure compréhension du fonctionnement de l'aide au commerce dans les pays bénéficiaires.

La spécificité de l'étude menée est double. (1) La distinction de la politique d'aide au commerce en trois catégories selon la classification générale de l'OCDE permet d'étudier l'effet hétérogène de l'aide au commerce liée respectivement à la politique commerciale, à l'infrastructure et à la productivité sur la qualité des exportations des bénéficiaires. (2) Nous étudions à la fois l'effet direct et l'effet d'entraînement de la politique d'aide au commerce, en régressant la qualité des exportations d'un bénéficiaire vers un pays partenaire donné sur la valeur de l'aide au commerce bilatérale reçue de ce partenaire donateur ainsi que sur la valeur de l'aide au commerce reçue de l'ensemble des pays donateurs à l'exception de ce partenaire.

Un résultat important est que l'aide au commerce dans le domaine de la politique commerciale et de l'infrastructure économique permet à la plupart des bénéficiaires d'améliorer leur position dans l'échelle de qualité mondiale (hors OCDE), tandis que l'aide au commerce dans le domaine de la capacité productive semble beaucoup moins efficace pour améliorer leur position de qualité.

Chapitre 2 : Vérification de la qualité et intermédiaires commerciaux en Chine

Un élément essentiel dans l'effort de montée en qualité des exportations est le travail de vérification de la qualité des produits notamment ceux qui sont différenciés et donc pour lesquels il n'existe pas de standards simples à appliquer. En raison de l'asymétrie d'information, le prix d'un produit n'est pas un signal efficace de sa qualité. Même si les acheteurs internationaux sont prêts à payer un prix plus élevé, il n'est pas certain qu'ils obtiendront des produits de meilleure qualité en raison d'un mécanisme de sélection adverse. L'incapacité des producteurs de bonne qualité de se distinguer de ceux de mauvaise qualité conduit à leur sortie du marché. L'incapacité à vérifier et contrôler la qualité des produits réduit l'incitation des exportateurs à améliorer la qualité de leurs produits. Dans ce contexte, l'exploration d'un mécanisme efficace de vérification de la qualité des exportations est un élément indispensable de cette thèse.

Les intermédiaires commerciaux sont souvent modélisés théoriquement comme permettant d'atténuer les problèmes de qualité grâce à leur investissement dans la technologie d'inspection ou à des incitations pour protéger leur réputation de vendeurs de qualité (Biglaiser & Friedman, 1994). Dans le contexte du commerce international, où l'asymétrie d'information est plus grande encore que sur un marché domestique, des intermédiaires pourraient être utilisés pour contrôler la qualité des produits et ensuite révéler cette qualité aux consommateurs (Dasgupta & Mondria, 2012). Cette hypothèse de vérification de la qualité suggère une plus grande prévalence des intermédiaires commerciaux dans les exportations de biens plus différenciés. Toutefois, lorsque les contrats complets ne sont pas possibles, les intermédiaires commerciaux pourraient avoir intérêt à duper leurs clients et donc ne pas soutenir les efforts de montée en qualité.

Ces deux points de vue théorique opposés font écho aux résultats empiriques contrastés sur la relation entre la différenciation verticale des produits et la prévalence de l'intermédiation commerciale. D'un côté, le rôle de tri qualitatif mené par les intermédiaires commerciaux a été clairement établi dans le cas des négociants à Hong Kong (Feenstra et Hanson, 2004). Le rôle de ces intermédiaires dans le commerce entre la Chine et le reste du monde s'est particulièrement important pour les produits différenciés, ce que Feenstra et Hanson (2004) interprètent comme la preuve qu'ils sont capables de sélectionner des producteurs chinois qui répondent aux normes de qualité étrangères. D'un autre côté, une relation négative a été observée entre la part des intermédiaires dans les exportations et le degré de différenciation des produits dans deux pays distincts: la Chine (Tang et Zhang, 2012) et l'Italie (Bernard et al., 2015). Ces résultats opposés sur le rôle de vérification de la qualité des intermédiaires sont troublants. Une possible explication tient au fait que ces études ne prennent pas en compte la grande hétérogénéité des intermédiaires commerciaux. Dans ce chapitre, nous réexaminons le rôle de vérification de la qualité joué par les intermédiaires dans le commerce international en exploitant l'hétérogénéité substantielle existant entre les intermédiaires. Concrètement nous distinguons deux types : les intermédiaires généralistes et les intermédiaires spécialisés.

Suivant l'intuition théorique de Dasgupta et Mondria (2012) selon laquelle les intermédiaires aident à surmonter le coût de l'information dû à l'incertitude de la qualité grâce à leur technologie spécialisée dans un secteur particulier, nous distinguons les deux catégories d'intermédiaires en fonction de la largeur de leur gamme de produits. Statistiquement, nous calculons un indice Herfindahl de la distribution des exportations à travers les différents produits au niveau de chaque entreprise. Comme on s'attend à ce que la gamme des produits exportée par une entreprise augmente avec la taille et la productivité de celle-ci (Bernard et al., 2010a; Bernard, Redding et Schott, 2011), nous faisons attention de purger ces associations mécaniques. Dans le détail, nous régressons l'indice de Herfindahl sur un polynôme quadratique de la taille de l'entreprise (représenté par la valeur des exportations) avec des effets fixes pour le type de propriété, puis nous prenons le résidu, dénommé indice de Herfindahl ajusté. Deux groupes d'intermédiaires sont distingués selon leur leur indice de Herfindahl ajusté est supérieur ou inférieur à la médiane: les intermédiaires spécialisés se caractérisent par une gamme étroite de produits tandis que les intermédiaires généralistes couvrent une gamme plus large.

Les résultats de ce chapitre montrent clairement que les intermédiaires spécialisés jouent un rôle de vérification de la qualité : (1) ils sont plus répandus dans les produits ayant une plus grande dispersion de qualité parmi les exportateurs locaux, et (2) leurs exportations ont une qualité supérieure à celle des produits exportés par les intermédiaires généralistes.

Nos premiers résultats sont estimés en suivant l'approche de Tang et Zhang (2012) qui examine la relation entre la prévalence de l'intermédiation commerciale et la dispersion de la qualité des exportations. Nous tenons cependant en compte de l'hétérogénéité des intermédiaires (intermédiaires généralistes et spécialisés). Les résultats suggèrent que les intermédiaires généralistes ne jouent pas le rôle de vérificateurs de la qualité sur le marché international contrairement aux intermédiaires spécialisés. Ce constat permet de réconcilier les résultats contrastés obtenus précédemment. Une autre avancée menée dans l'étude est de calculer la différenciation verticale au niveau d'un couple ville-produit et non pas seulement au niveau du produit (en global pour le pays). Cette approche permet ainsi de prendre en compte l'hétérogénéité spatiale en matière de différences de qualité en Chine. Nos données révèlent en effet d'importantes variations dans la dispersion de la qualité entre les villes chinoises ainsi que dans les produits. Nous découvrons une composante spatiale plutôt intuitive de la dispersion de la qualité : les villes plus ouvertes et accessibles ont tendance à avoir une plus grande dispersion de la qualité des produits exportés. Par ailleurs, la dispersion des qualités des produits varie fortement dans la dimension géographique mais également selon les produits. Les villes qui ont la réputation d'être des centres de haute qualité pour des produits particuliers ont une qualité moyenne supérieure et une dispersion de qualité inférieure dans ces produits. Nous observons également de façon constante un coefficient de variation plus faible de la dispersion de la qualité entre les villes exportatrices pour des produits homogènes par rapport à des produits différenciés. Cela donne à penser que la combinaison de la dimension de la ville et de la dimension du produit, par opposition à la seule dimension produit, est la plus appropriée pour l'analyse de la dispersion de la qualité. L'utilisation de données ayant la double dimension ville-produit permet en outre d'inclure des effets fixes produits qui absorbent l'ensemble des facteurs omis liant hétérogénéité de la qualité des produits et rôle des intermédiaires qui pourraient biaiser nos estimations. Le prix moyen et la qualité moyenne par exemple, ainsi que les possibilités de différenciation verticale au niveau des produits, sont en effet susceptibles d'être corrélés avec de nombreuses autres caractéristiques non observées des différents produits au niveau SH6 (Système harmonisé de classification des produits à six chiffres), qui peuvent à leur tour déterminer l'importance relative des intermédiaires dans les exportations. Par conséquent, notre approche empirique tient compte, par le biais d'effets fixes au niveau du produit et de la ville, des caractéristiques non observées propres au produit et à la ville, de manière à atténuer les problèmes d'endogènéité potentiels. En outre, dans nos tests de robustesse, nous rajoutons la dimension temporelle dans notre panel et confirmons l'existence d'une sélection dans l'utilisation d'intermédiaires, selon laquelle les exportations dans les industries (ville-produit) présentant de plus grandes différences de qualité entre fournisseurs sont plus susceptibles d'être acheminées par des intermédiaires spécialisés.

Notre deuxième série de résultats concerne la différence de qualité en niveau entre les intermédiaires spécialisés, les intermédiaires généralistes et les exportateurs directs. Nous examinons s'il existe une "prime de qualité" pour les intermédiaires spécialisés par rapport aux intermédiaires généralistes. Si les intermédiaires spécialisés jouent le rôle de vérificateurs de la qualité et aident à sélectionner les meilleurs produits, on s'attend à ce que la qualité de leurs produits d'exportation soit supérieure à celle des intermédiaires généralistes, même si la qualité de leurs exportations peut être inférieure à celle des exportateurs directs. En outre, si la spécialisation des intermédiaires dans une gamme de produits étroite incite davantage à être un fournisseur fiable de biens de qualité, il devrait y avoir une relation monotone entre le seuil (en percentile) utilisé pour distinguer les intermédiaires spécialisés et la qualité de leurs produits. Par conséquent, nous nous attendons à ce que la qualité des biens exportés augmente avec la valeur seuil dans la distribution de la gamme de produits utilisée pour identifier les intermédiaires spécialisés.

Notre approche empirique consiste à régresser la qualité estimée des exportations au niveau de l'entreprise sur des variables muettes dénotant les intermédiaires spécialisés et généralisés. La catégorie omise est celle des exportateurs directs. Nous constatons que la qualité des exportations est nettement inférieure pour les biens qui sont acheminés par des intermédiaires, ce qui est en ligne avec les travaux suggérant que les intermédiaires traitent systématiquement les exportations des entreprises les moins efficaces (Akerman, 2012 ; Bernard et al., 2010a ; Ahn et al., 2011 ; Crozet et al., 2013). Toutefois, les produits acheminés par les intermédiaires spécialisés sont de meilleure qualité que ceux des intermédiaires généralistes, et la qualité à l'exportation est supérieure lorsque le panier de l'intermédiaire spécialiste couvre une gamme plus restreinte de variétés, ce qui confirme une "prime de qualité" pour les intermédiaires spécialisés par rapport aux intermédiaires généralisés, et suggère qu'un cœur de compétence limité incite davantage à être un fournisseur fiable de produits de qualité.

Les contributions de ce chapitre sont que (1) nous proposons une nouvelle approche pour distinguer statistiquement les intermédiaires spécialisés des intermédiaires généralisés. Ce travail de base permet d'explorer plus avant l'effet hétérogène des intermédiaires sur le plan empirique. Ainsi, ce travail joue le rôle de complément aux études théoriques sur les intermédiaires ; (2) à partir de la mise en évidence d'une hétérogénéité substantielle entre intermédiaires, nous offrons la preuve que le rôle de vérification de la qualité n'est joué que par des intermédiaires spécialisés (et ne s'appliquent pas aux intermédiaires généralistes), ce qui résout la controverse sur l'hypothèse de vérification de la qualité des intermédiaires existant dans la littérature. Il semble que bien que les intermédiaires spécialisés jouent le rôle de vérificateur de la qualité dans le commerce international, leur contribution est masquée dans les données globales lorsque les intermédiaires spécialisés ne représentent qu'une part faible du commerce intermédié. Le résultat validant le rôle de vérification de la qualité pour les négociants de Hong Kong découle de l'importance des intermédiaires spécialisés pour ces échanges (Feenstra et Hanson, 2004). Inversement les intermédiaires à l'œuvre dans les études de Tang et Zhang (2012) et Bernard et al., (2015) seraient majoritairement des généralistes ce qui expliquent qu'ils n'identifient pas une rôle vérification de la qualité effectuée par les intermédiaires.

Chapitre 3: Orientation à l'exportation, incertitude de la demande et prime à l'innovation en Chine

Les deux premiers chapitres portent sur la façon dont les gouvernements et les intermédiaires contribuent à améliorer la qualité des exportations, le troisième chapitre s'intéresse au comportement de la firme exportatrice elle-même. Il examine le lien entre l'orientation à l'exportation et la performance des entreprises en matière d'innovation. L'accent est mis sur le rôle joué par l'incertitude de la demande extérieure sur la formation de ce lien. Les conclusions de ce chapitre aident à comprendre la sous-performance en matière d'innovation des entreprises chinoises orientées à l’export, et donc les difficultés des exportateurs à accroître la qualité de leurs produits.

La littérature existante met l'accent sur le lien de causalité entre l'hétérogénéité des entreprises et le commerce : certaines études s’intéressent à l'impact de la productivité sur le comportement commercial, tandis que d’autres examinent le lien inverse entre le commerce et la productivité. Ces dernières examinent les divers canaux par lesquels la libéralisation du commerce renforce la productivité et l'innovation des entreprises exposées.

Ce chapitre étudie quant à lui comment le choix de l'orientation des ventes (vers le marché domestique ou à l’international respectivement) affecte la performance en matière d'innovation des entreprises et comment l'incertitude liée à la demande modifie ce lien. L’approche est empirique et s’appuie sur des données en panel d'entreprises chinoises informant à la fois sur leurs ventes et sur leurs investissements en R & D.

Il existe un débat intense sur la possibilité que l'innovation soit induite par l'exportation. Plusieurs travaux témoignent d’un lien empirique positif entre l'activité d'exportation ex ante et l’effort d’innovation et la productivité ex post (De Loecker, 2007, 2013 ; Mallick et Yang, 2013 ; Biesebroeck, 2005). Toutefois, dans le contexte chinois si les exportateurs innovent plus que les non-exportateurs on observe un lien négatif entre innovation et poids des exportations dans les ventes totales au niveau firme. L’essor des exportations semble réduire l’incitation de la firme à innover. Plusieurs explications ont été avancées pour justifier ce lien négatif dans le cas chinois. Une première explication tient au rôle important d’activités d’assemblage en Chine (Manova et Yu, 2016; Dai et al., 2016). Les entreprises engagées dans ces activités se contentent de fabriquer les produits en suivant les cahiers des charges de leurs donneurs d’ordre et ne sont pas du tout incitées à innover. Une seconde explication tient à la concurrence existant sur le marché international qui réduit les marges bénéficiaires et l'investissement dans l'innovation des exportations, en particulier pour les entreprises à faible productivité (Aghion et al., 2018).

Une autre explication découle des effets désincitatifs de l'incertitude de la demande sur les marchés internationaux (Arrow, 1968 ; Bernanke, 1983 ; Mc Donald & Siegel, 1986 ; Bertola, 1988 ; Pindyck, 1988 ; Dixit & Pindyck, 1994 ; Guiso & Parigi, 1999 ; Bloom, 2007 ; Bloom et al., 2007). La volatilité de la demande aurait un rôle négatif sur l'investissement en R&D en raison de l'irréversibilité des investissements en R & D (Guiso & Parigi, 1999 ; Bloom, 2007; Bloom et al., 2007). L’importance de l’incertitude dans le contexte du commerce international a été mise en évidence dans de nombreuses études. Elle se traduit par une fréquence élevée d'entrée et de sortie de nouveaux exportateurs sur le marché international. Les exportateurs sont embarqués dans un processus d’essai et erreur (Nguyen, 2017). L’incertitude liée à la demande internationale affecte non seulement la survie des entreprises mais affecte la valeur des transactions (marges extensive et intensive) ainsi que le prix à l'exportation (de Sousa et al., 2018). Peu d'études portent par contre sur l'impact de l'incertitude sur les activités d'innovation des exportateurs. C'est l'objet de ce chapitre qui étudient le lien entre le choix de l'orientation des ventes vers le marché d'exportation et l'investissement en R&D des entreprises.

L'incertitude de la demande est mesurée par trois variables distinctes. Une première variable porte sur l'écart culturel entre les pays de destination et la Chine lié aux différences linguistiques, historiques et culturelles (Morales et al., 2014 ; Fernandes et Tang, 2014). La différenciation culturelle empêche les exportateurs de prévoir correctement les préférences des clients à l'étranger à partir de leurs propres préférences, habitudes et croyances. Une deuxième mesure porte sur la volatilité de la taille de la demande et est calculée comme la dispersion du PIB et du PIB par habitant dans le pays de destination. Une troisième mesure reflète les risques au niveau des pays et correspond à l'indice de risque économique et financier publié par l'ICRG. Un niveau plus élevé de risques économiques et financiers dans les pays de destination d'une firme est facteur d'incertitude quant à la taille de la demande potentielle.

Différemment de la littérature existante qui compare l'effort d'innovation selon qu'une firme exporte ou pas, la variable clef dans ce travail est l'intensité des exportations (à savoir si les ventes sont principalement à destination du marché domestique ou du marché international). Les données au niveau des entreprises chinoises révèlent une distribution bimodale de la part des exportations dans les ventes totales. La comparaison des efforts en R&D entre les exportateurs orientés à l'exportation et ceux orientés plutôt vers le marché intérieur fait ressortir une association négative. Il apparait en effet qu'une firme dont le marché international remplace le marché domestique comme destination première des ventes réduit ses investissements en R&D. Les résultats fournissent des explications possibles de ce lien négatif notamment en mettant en lumière les conditions qui renforcent cette association inverse. Ainsi l'effet négatif sur la R&D est particulièrement prononcé quand les activités à l'exportation sont soumises à une incertitude forte et quand les entreprises entrent sur de nouveaux marchés et ne disposent pas d'une longue expérience internationale. Nous mettons en évidence un effet hétérogène selon le niveau de productivité de la firme. La productivité semble apporter une protection contre les répercussions néfastes de l'incertitude. Ainsi le lien entre orientation à l'exportation et investissements en R & D est positif même si l'incertitude est élevée pour les entreprises initialement plus productives, tandis que l'effet est inversé pour les entreprises moins productives, l'effet négatif de l'incertitude dominant.

Nos résultats suggèrent ainsi que l'incertitude de la demande internationale impose un coût fixe

qui décourage les efforts d'innovation des entreprises exportatrices. Seule une productivité élevée et une expérience longue permettent aux entreprises de surmonter l'impact néfaste de l'incertitude dans l'activité internationale et donc d'innover.
Ce chapitre contribue ainsi à expliquer pourquoi une participation accrue à l'exportation ne s'accompagne pas d'une augmentation des investissements dans l'innovation et pourquoi les politiques d'incitation à l'innovation peuvent être impuissantes à renforcer l'innovation d'entreprises fortement engagées à l'international et donc soumises à une forte incertitude.

En résumé, cette thèse, composée de trois chapitres relatifs à la qualité des exportations, éclaire les déterminants de la qualité des exportations en conduisant des études empiriques portant sur des données au niveau des pays, des secteurs et des entreprises, respectivement. Les résultats de cette thèse mettent en évidence un impact positif mais limité de la politique d'Aide au Commerce sur la qualité des exportations des pays récipiendaires, la possibilité que des intermédiaires spécialisés aident à résoudre les problèmes de qualité et l'effet néfaste de l'incertitude de la demande internationale sur l'innovation des exportateurs.

Chapter 1

Aid for Trade and the Quality of Exports

I. Introduction

Despite the pivotal role of aid for trade (AfT) in international development assistance, its impact is only recently assessed with a focus on its effectiveness in promoting the trade value of the recipients (Calì and te Velde, 2011; Helble *et al.*, 2012; Pettersson and Johansson, 2013; Vijil and Wagner, 2012). This paper investigates the effects of AfT on trade from a new angle: we study whether and how AfT affects the quality of the recipient countries' exports and hence their positions in the global quality ladder.

The contribution of this research is twofold. First, our research adds a new aspect – i.e. the quality of exports – to the recent AfT effectiveness evaluation literature where AfT is shown to have some positive but limited impact on trade value (Calì and te Velde, 2011; Helble *et al.*, 2012; Pettersson and Johansson, 2013; Vijil and Wagner, 2012).[1] While AfT funds target specifically at the building of the recipient countries' supply-side capacity for deeper integration into the world economy (OECD/WTO, 2007), the expansion of global value chains presents a new concern for the effectiveness of AfT: in response to the increasing fragmentation of production across borders, AfT is now being geared toward the needs for enhancing an aided country's comparative advantage in the value chain through the provision of products and services at internationally competitive cost and quality (Lammersen and Roberts, 2015; OECD/WTO, 2013). Following this rationale, we first provide an assessment of the impact of AfT on the quality of the recipients' exports, distinguishing the effects from AfT of different categories as well as the effects for different export markets. Second, we examine the time pattern of the quality effects of AfT and look into the intensive and extensive margins along the market and product dimensions. A close look at the market and product dynamics gives useful information about the sources of the effects observed, offering a more accurate anatomy and deeper understanding of the workings of AfT in recipient countries.

II. Methodology and Data

A widely used proxy for product quality is product price (or unit value). The main problem with price as a measure of quality is that it reflects not only quality but also the markup and productivity of firms. To isolate the "true" quality component from product prices, we adopt an estimation approach for differentiated products used widely in the empirical IO literature (e.g. Anderson *et al.*, 1988, 1992). Specifically, we estimate the following structurally derived

[1] Using non-stationary panel estimators, Nowak-Lehmann *et al.* (2013) find negative but insignificant impact of general aid (official development assistance which includes AfT) on recipients' exports to donors.

equation as in Khandelwal *et al.* (2013):

$$\ln q_{ijkt} + \sigma_k \ln \rho_{ijkt} = \omega_{jt} + \omega_k + E_{ijkt} \tag{1}$$

where q_{ijkt} is the quantity of product k exported by country i to country j in year t; $pijkt$ is the price and σk is the elasticity of substitution of the product; the fixed effect ωjt controls for all market-year-specific characteristics such as income and general price index; and the fixed effect ωk is introduced to control for all product-specific factors such as the unit of measurement (e.g. kg, tonne, meter), ensuring the comparability of quantities and prices across products. The inferred quality can then be recovered from the residual of the regression as $\hat{\lambda}_{ijkt} = \hat{E}_{ijkt} / (\sigma_k - 1)$. An institutional explanation of this estimate of quality is as follows. When product prices are the same, consumers would prefer and buy a larger quantity of higher-quality products. A bigger E means a higher quantity of sales q when product prices p are controlled for, hence reflecting a higher quality λ of the product. To facilitate the following country-country-year-level analysis, we further construct $\hat{\lambda}_{ijt}$ as a weight average of $\hat{\lambda}_{ijkt}$ with the weight being the share of each product in the export value.[2]

The effect of AfT on the quality of exports is estimated from regressions that take the following form:

$$\hat{\lambda}_{ijt} = \alpha + \sum_m \beta^m AfT^m_{ij,t-stot-1} + \sum_m \theta^m OAfT^m_{j,t-stot-1} + X\Gamma_{ijt} + \delta_{it} + \mu_{jt} + v_{ijt} \tag{2}$$

Where $AfT^m_{j,t-stot-1}$ is the log value of AfT from donor j to recipient i, summed from year t – s to year t − 1; the superscript m denotes one of the three categories of AfT that are broadly related to trade policy, economic infrastructure, and productive capacity; OAf T is the sum of AfT from all donors except country j; δ_{it} and μ_{jt} capture all time-variant importer and exporter characteristics respectively; X is a vector that contains both time- variant and -invariant country-pair-specific controls (population weighted distance and dummies for sharing a common official language, for ever being in a colonial relationship, and for whether being in a regional trade agreement);[3] $vijt$ is the error term and all other parameters are estimated coefficients.

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[2] There are three problems with country-country-product-year-level regressions. First, because of the inter-sectoral nature of a great part of AfT (e.g. technical assistance on trade policy) even the most disaggregated AfT statistics cannot be cleanly aligned with products or industries. Second, such disaggregated level regressions are computationally very demanding especially with high-dimensional fixed effects. Third, results of regressions at this level may be driven by the bias from the fact that some observations are assigned a large weight in the sample simply because some countries happen to export

[3] Lee *et al.* (2015) find that WTO members are more likely to receive AfT than non-members. However, we do not include WTO membership dummies for countries or a dyadic dummy indicating the

Our trade data is from CEPII-BACI. All products are defined at 6-digit HS level (1992 version). The AfT data is obtained from OECD Creditor Reporting System (CRS). Following Khandelwal *et al.* (2013), product-specific elasticity of substitution are taken from Broda *et al.* (2006) at the median of their multi-country sample.[4] Bilateral country relationship variables are from Agarwal and Wang (2016) who extend the CEPII Gravity dataset to include more recent years. The period under study is 2002-2010 as complete AfT records are only available after 2002 (Calı́ and te Velde, 2011). We further restrict our sample to non-OECD exporters and exclude trade with major non-OECD donors (China, India, Saudi Arabia, and Brazil) for which aid data is not available in OECD CRS and the inclusion of these countries would be likely to bias our results.

III. Results

Following the literature (Calı́ and te Velde, 2011; Helble *et al.*, 2012; Pettersson and Johansson, 2013), we split AfT into three categories using the broad classification by the OECD.[5] Our baseline results are presented in Table 1, where we allow for longer time lags for AfT to have effects on exports than in the above studies. Columns (1)-(5) show that overall AfT in the broadly defined areas of trade policy ("trade policy, regulations, and trade-related adjustment") has the largest positive effect on the quality of exports, and the effect increases when AfT is cumulated over time, implying that the impact takes time to come into full effect. Interestingly, AfT in trade policy from other OECD donors also has a markedly strong and statistically positive impact especially when time lags are taken into account, indicating that some externality may exist between donor and non-donor markets for the quality effect of AfT. Taken as a whole, the average elasticity of quality with respect to AfT is between 0.01 to 0.02 , indicating that a 50% increase in the value of AfT in trade policy would increase export product quality by 0.5%-1%.

common WTO membership of importing and exporting countries because they would be absorbed by country-year fixed effects here.

[4]The Broda *et al.* (2006) sample reports country-product-specific elasticities of substitution, but the numbers of countries reported for different products are extremely unbalanced, ranging from 1 to 73.

[5]The classification is accessed via OECD website at:http://www.oecd.org/dac/aft/Aid-for-trade-sector-codes.pdf.

Table 1. Heterogeneous effects of AfT

	All markets					OECD markets				
	AfT: Past 1 year (1)	AfT: Past 2 years (2)	AfT: Past 3 years (3)	AfT: Past 4 years (4)	AfT: Past 5 years (5)	AfT: Past 1 year (1)	AfT: Past 2 years (2)	AfT: Past 3 years (3)	AfT: Past 4 years (4)	AfT: Past 5 years (5)
AfT trade policy	0.007**	0.010***	0.011***	0.011***	0.013***	0.006*	0.008***	0.009***	0.010***	0.006*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)
OAfT trade policy	0.002	0.009***	0.014***	0.015***	0.019***	0.002	0.005	0.004	-0.002	0.002
	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)	(0.007)	(0.007)	(0.009)	(0.011)	(0.007)
AfT infrastructure	0.005**	0.004*	0.004	0.003	0.003	0.003	0.003	0.001	0.002	0.003
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)
OAfT infrastructure	0.001	0.011**	0.010	0.008	0.015*	-0.004	0.013	0.016	0.029*	-0.004
	(0.004)	(0.005)	(0.007)	(0.007)	(0.008)	(0.008)	(0.012)	(0.013)	(0.018)	(0.008)
AfT productive	0.002	0.002	0.000	0.000	-0.002	0.007***	0.007***	0.007**	0.005	0.007***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)
OAfT productive capacity	0.008**	-0.006	-0.010*	-0.010*	-0.020***	0.007	-0.013	-0.015	-0.022	0.007
	(0.003)	(0.004)	(0.005)	(0.005)	(0.007)	(0.003)	(0.004)	(0.005)	(0.005)	(0.007)
Dyadic controls: distance, and dummies for common language, colonial relationship in the past, and common regional trade agreement										
Exporter-year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	136,455	119,140	101,747	83,881	66,122	136,455	119,140	101,747	83,881	66,122
Adj. R^2	0.181	0.188	0.200	0.201	0.204	0.269	0.277	0.294	0.293	0.294

Note. This table reports the estimated effects of different categories of AfT on the quality of exports based on eq. (2). Each observation is an exporter-importer-year cell. Columns (1)-(5) look at all export markets while Columns (6)-(10) look at OECD markets only. "AfT" is the log value of aid for trade granted by a donor (importer) to a recipient (exporter) in a given year. "OAfT" is the log value of aid for trade granted by other OECD donors than the importer to a recipient (exporter) in a given year. Both AfT and OAfT are taken as a cumulative value in a specific length of period in the past, where the length of the period is noted in the headers of columns. Standard errors (in parentheses) are clustered within country-pairs. ***, **, and * indicate significance at the 1%, 5% and 10% levels respectively.

Similarly, AfT in economic infrastructure improves the quality of exports, but the effects are statistically less significant. AfT used for building productive capacity, however, has no discernible effect on the quality of exports to the donor, and AfT from the rest of the OECD members may actually lower the quality of exports to a given donor country. While the exact causes of this quality "downgrading" effect requires a closer investigation into the finer content of AfT and the policy transmission channels,[6] a possible explana- tion is that AfT in this category may be "tied" to the procurement from the donor and thus compete away resources for exporting high-quality goods to other markets.[7]

Columns (6)-(10) restrict the export destinations to OECD countries only. Now it emerges that the quality effect of AfT in trade policy gets weaker for recipient-donor trade with the elasticity falling slightly below 0.01, and the effect disappears for AfT from other OECD donors. This finding differs from Columns (1)-(5) and the difference suggests that the cross-market externality of AfT is only limited to non-OECD markets. The fact that other OECD members do not benefit from this spillover probably signals some competition among OECD donors in a manner which is consistent with the above- mentioned "tied aid" hypothesis. The effect of AfT in economic infrastructure basically still remains insignificant. AfT in productive capacity now improves quality upto four years down the line but not for other OECD markets, which, when contrasted to Columns (1)-(5), indicates that more productive-capacity-related AfT leads to exports of higher- quality products, but this relationship only exists among OECD markets. The negative externality among OECD donors still persists although it is less precisely estimated with a much smaller sample.

To see how AfT changes the recipients' overall positions in the global quality ladder, we compare their predicted positions with AfT against their predicted positions without AfT, taken as mean values in normalized scales,8 using the estimated model from Column (5). As shown in Figure 1, it seems that AfT in trade policy and economic infrastructure enable most recipients to upgrade their positions in the global (non-OECD) quality ladder (both by 2% on average), while AfT in productive capacity seems much less effective in raising the recipients' quality positions (by -2% on average),9 a finding broadly consistent with Table 1.

[6] See Bourguignon and Sundberg (2007) for a general discussion on the possible causes for the mixed effects of AfT found in reduced-form analysis.

[7] See Wagner (2003), Helble *et al*. (2012), and Pettersson and Johansson (2013), among others, for more detailed discussions on "tied aid" in trade context.

[8] The normalization is constructed as $(\hat{\lambda}_{ijt} - \min(\hat{\lambda}_{ijt}))/(\max(\hat{\lambda}_{ijt}) - \min(\hat{\lambda}_{ijt})$.

[9] Note that the upgrade is less statistically significant for AfT in economic infrastructure judging from the *t*-statistics in Table 1.

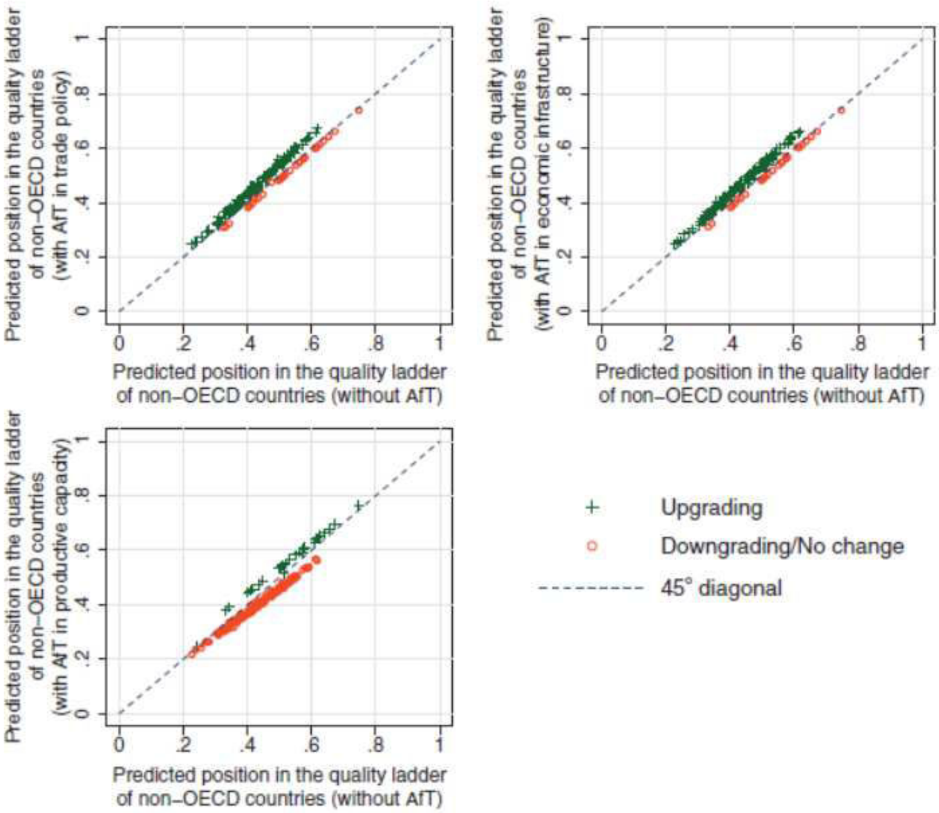

Figure 1. Predicted effects of AfT on recipients' positions in the global (non-OECD countries) quality ladder, 2002-2010.

Note. Horizontal and vertical axes are the relative positions of a country in the global quality ladder with and without a specific type of AfT, predicted from the estimated model in Column (5) of Table 1. Each data point represents a non-OECD exporter. The symbols of "+" denote countries whose predicted relative positions, ceteris paribus, upgrade in the ladder because of a specific type of AfT they actually received, and the symbols of "◦" denote those whose predicted relative positions, ceteris paribus, downgrade or have no change as a result of a specific type of AfT they were actually granted. The dividing line between quality ladder upgrading and downgrading (and no change) is the 45◦ diagonal (dashed line).

Table 2 examines the intensive and extensive margins of the quality effect of AfT along the market and product dimensions, where AfT is cumulated over the past five years.[10] Columns (1) and (5) are simply copied from Table 1 for the ease of comparison. As opposed to Column (1) where all market-product observations are included, the sample in Column (4) is trimmed to continued market-product pairs only that appear in all years of the sample period. Columns (2) and (3) focus on one dimension and consist of continued markets and continued products respectively. The comparisons of these columns thus reveal the dynamic sources of the average

[10] The conclusions we have here are not qualitatively sensitive to the measure of AfT in terms of lagged periods.

quality effect of AfT at different margins. Specifically, estimates in Column (4) reflect the most narrowly defined intensive margin, i.e. how AfT affects export quality within existing market-product pairs. The difference between Columns (1) and (2) in sample size reflects the net addition of export markets by any of the AfT recipients, and the equality of sample size between Columns (1) and (3) means no new products were added by any exporters in the whole period.

Table 2. Market and product dynamics of the quality effect of AfT in the past 5 years

	All markets				OECD markets			
	Whole sample (1)	Continued markets (2)	Continued products (3)	Continued pairs (4)	Whole sample (5)	Continued markets (6)	Continued products (7)	Continued pairs (8)
AfT trade policy	0.013***	0.014***	0.013***	0.007*	0.010***	0.011***	0.011***	0.006
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
OAfT trade policy	0.019***	0.023	0.012***	0.004	-0.002	0.011	-0.010	-0.000
	(0.005)	(0.016)	(0.004)	(0.015)	(0.011)	(0.015)	(0.011)	(0.015)
AfT infrastructure	0.003	0.002	0.003	0.004	0.002	-0.000	0.001	0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
OAFT infrastructure	0.015*	-0.012	0.012*	-0.046**	0.029*	-0.011	0.008	-0.042**
	(0.008)	(0.019)	(0.007)	(0.022)	(0.018)	(0.018)	(0.015)	(0.021)
AfT productive capacity	-0.002	-0.001	0.000	0.001	0.005	0.008**	0.005	0.004
	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)
OAfT productive capacity	0.020***	-0.028	0.014***	0.092	-0.022	-0.077	-0.015	-0.005
	(0.007)	(0.074)	(0.005)	(0.073)	(0.017)	(0.077)	(0.014)	(0.077)
Dyadic controls: distance, and dummies for common language, colonial relationship in the past, and common regional trade agreement								
Exporter-year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	66,122	42,064	66,122	42,064	14,644	12,984	14,644	12,984
Adj. R^2	0.204	0.220	0.234	0.275	0.294	0.294	0.340	0.399

Note. This table reports the estimated effects of different categories of AfT on the quality of exports based on eq. (2) with various samples of the data as defined in the headers of columns. Each observation is an exporter-importer-year cell. Columns (1)-(4) look at all export markets while Columns (5)-(8) look at OECD markets only. Columns (1) and (5) are copied from Columns (5) and (10) in Table 1. "AfT" is the log value of aid for trade granted by a donor (importer) to a recipient (exporter) in a given year. "OAfT" is the log value of aid for trade granted by other OECD donors than the importer to a recipient (exporter) in a given year. Both AfT and OAfT are taken as a cumulative value in the past five years. Standard errors (in parentheses) are clustered within country-pairs. ***, **, and * indicate significance at the 1%, 5% and 10% levels respectively.

Although we lose some statistical significance in the continued market sample, totally new markets or products do not affect the quality effect of AfT in trade policy. However, comparing Column (2) against (4), we see that half of the quality effect of AfT in trade policy is due to the addition of higher-quality products in continued markets. A similar pattern is found when contrasting Column (3) to (4), which shows that for continued products AfT encourages the exports of higher-quality varieties to new markets, and this also applies to AfT from other OECD donors. When it comes to AfT in economic infrastructure and productive capacity, most margins do not play a notable role here, although the quality effect spills over more to newly exported markets. The above findings concerning AfT in trade policy are robust to the subsample of OECD markets, while the margins for other categories of AfT now become less prominent. Together, these observations suggest that AfT causes changes in quality mainly through the expansions of the ranges of products and markets in the developing world.

IV. Conclusion

We document that aid for trade has some discernible effects on the quality of the recipient countries' exports. In particular, a 50% increase in the value of AfT received from a donor for assistance in trade policy increases the recipient's export product quality by 0.5%-1% for exports to both donor and other OECD markets. On average, the actual AfT received in trade policy raises the relative position of the recipient country in the quality ladder of all non-OECD countries by 2%. About half of this observed quality upgrading effect is driven by the fact that AfT raises the quality of existing products in existing markets, with the other half coming from higher-quality products being added to the continued markets and higher-quality continued products being exported to new markets. Our research is subject to limitations and can be extended in several ways. For example, our reduced-form results do not reveal any information about the policy making process and transmission channels of AfT; therefore more work needs to be done to open the "black box" of the causality chain (Bourguignon and Sundberg, 2007). It is also worth integrating the current estimation with a global value chain analysis to see how exactly AfT repositions a country' comparative advantage in the global production network.

Chapter 2

Quality screening and trade intermediaries:

Evidence from China

I. Introduction

A considerable proportion of international trade is handled by so-called intermediaries. Intermediaries such as wholesalers, trading companies, and import–export companies, account for 22 percent of the exports of the largest trading nation all over the world, China (Ahn, Khandelwal, and Wei, 2011).[1] Understanding the factors that give rise to intermediaries in exporting is thus key. An extensive theoretical literature rationalizes the role of intermediaries in the economy,[2] and in particular in international trade. Three main roles have been put forward in this context: (1) helping to match sellers/exporters to foreign buyers;[3] (2) reducing trade costs;[4] and (3) mitigating adverse selection by checking quality.[5] There is now well-accepted empirical evidence that intermediaries alleviate difficulties in reaching less accessible markets through the first two channels. However, there is much less consensus on the hypothesis of quality screening.

In this paper we use export data at the product level for Chinese exporters to investigate the quality-screening role of intermediaries. In theory, an intermediary is in a good position to alleviate quality problems because of prior investment in inspection technology or incentives to protect their reputation as a quality seller (Biglaiser and Friedman, 1994). In the context of international trade, where information asymmetry is greater, intermediaries could be used to screen the quality of products and then reveal this quality to consumers (Dasgupta and Mondria, 2012). This quality-verification hypothesis suggests a greater prevalence of trade intermediation in the exports of goods that are more differentiated. However, when complete contracts are not possible, trade intermediation is prone to delays. Intermediaries may shirk from the costly investments in specialized physical and human capital required for quality inspection, and hence underinvest in quality signaling from the perspective of their clients (Tang and Zhang, 2012). These two opposing views mirror the contrasting empirical results on the relationship between vertical product differentiation and the prevalence of trade intermediation (Feenstra and Hanson, 2004; Tang and Zhang, 2012; Bernard, Grazzi and Tomasi, 2015; Ahn et al., 2011). On the one hand, the quality-sorting role of intermediary firms has clearly been established for traders in

[1] This share is 10 percent of total exports in the United States (Bernard et al., 2010a), 11 percent in Italy (Bernard et al. , 2015), 20 percent in France (Crozet et al., 2013), and 35 percent in Chile (Blum, Claro, and Horstmann, 2010).

[2] See Spulber (1996) for a review of the roles of middlemen in general.

[3] The initial models viewed intermediaries as agents who reduce the search costs of finding international buyers and sell- ers (Rauch and Watson, 2004; Petropoulou, 2008; Antras and Costinot, 2011).

[4] Various models extend Melitz (2003) to account for intermediary activity. These typically assume an intermediation technology that allows intermediaries to exploit some kind of export advantage (such as economies of scope or better knowledge) over small exporting producers (Ahn et al., 2011; Akerman, 2017; Blum et al., 2010; Bernard et al., 2010a; Crozet et al., 2013; Felbermayr and Jung, 2011).

[5] See Biglaiser (1993), Biglaiser and Friedman (1994), and Li (1998).

Hong Kong (Feenstra and Hanson, 2004). Their role in intermediating trade between China and the rest of the world has been shown to be greater for differentiated products, which Feenstra and Hanson (2004) interpret as evidence that they are able to select Chinese producers that meet foreign quality standards. On the other hand, a negative relationship has been observed between the share of intermediaries in exports and the degree of product differentiation in two different countries: China (Tang and Zhang, 2012) [6] and Italy (Bernard et al., 2015).

Using Chinese firm-level export data we uncover substantial heterogeneity between intermediaries, and distinguish two types based on the concentration of their export bundles: generalized and specialized intermediaries.[7] We argue that the latter group is characterized by enhanced quality-verification activities. Our results suggest a selection into intermediary use based on the intrinsic features of the product being traded: products with a greater degree of differentiation and need for quality verification tend to be disproportionately handled by intermediaries that operate as quality-control agents, that is, specialized intermediaries.

We do not model intermediaries of different types explicitly, and hence do not try to single out an underlying difference between the two types of intermediaries. These may for example differ in terms of investments in screening technology or long-term relationships with both customers and buyers. Compared with generalized intermediaries, whose product range can cover many different unrelated industries, specialized intermediaries focus on a narrower set of products with greater export value.[8] This larger scale likely allows specialized intermediaries to develop expertise on the particular production process of the products they cover and profitably invest in the costly quality-screening process that applies to their product line. Also, as niche players they have greater incentives to protect their reputation as reliable suppliers of quality goods.

We propose two empirical results that emphasize the quality-verification role of specialized intermediaries. First, specialized intermediaries are more likely to be found in quality-differentiated products and, second, they export products of much higher quality than do generalized intermediaries.

Our first set of results refers back to the empirical findings in Tang and Zhang (2012). We

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[6] Ahn et al. (2011) find that the relative price of intermediaries compared with that of direct exporters does not vary sig- nificantly with the product's scope for quality differentiation, suggesting little quality sorting by intermediary firms.

[7] Intermediary heterogeneity also appears in some theoretical work: intermediaries vary in terms of their ability to screen product quality (Dasgupta and Mondria, 2012) or the size of their networks (Rauch and Watson, 2004).

[8] As indicated in Table 2, in our data the average export value per HS6 is eight times higher for specialized than for gen- eralized intermediaries.

use the same data set of Chinese exports in 2005,[9] and follow their approach of looking at the product-level relationship between the prevalence of trade intermediation and the dispersion of export quality.[10] Our approach differs in that we account for two existing types of intermediaries: generalized and specialized, the latter group having a quality-verification role. Shanghai Silk International Trade Company (SSTC) is a good illustration. This is an affiliate of Shanghai Silk Group Co. Ltd., whose business line is limited to garments. SSTC claims that the products it delivers are tested extensively in a certified textile-testing laboratory.[11] Its website announces that SSTC has established long-term stable trade relations with over a thousand customers around the world, such as Wal-Mart and ZARA, who chose SSTC for its excellence in the whole process from fashion design and product management to product testing and quality control.[12] Our results show that accounting for the heterogeneity of intermediaries substantially changes the findings in Tang and Zhang (2012). While we confirm that intermediaries overall focus on products that are less differentiated, we show that specialized and generalized intermediaries differ in that the former disproportionately handle exports of products with substantial variation in supplier quality, attesting to their quality-verification role.[13] We calculate the Herfindahl index of the firm-level distribution of export sales over products conditional on the effect of ownership and size in a regression framework. Our baseline approach distinguishes specialized and generalized intermediaries according to the median of this conditional concentration index. Our results are robust to the use of alternative cutoffs and a number of sensitivity checks. Our exploration of the destination-country dimension further strengthens our argument. To the extent that specialized intermediaries can help screen product quality for buyers, this function should be more pronounced for more distant buyers, who tend to have less information about the sellers. We include interaction terms between country characteristics and product-quality differentiation and find greater support for quality verification in more distant countries with fewer ethnic Chinese.

Our second set of results relates to the difference between intermediaries and direct exporters

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[9] We follow Ahn et al. (2011) and Tang and Zhang (2012) and define intermediaries as firms with certain Chinese char- acters suggesting a trading role in their name.

[10] We use the structural-based measure of quality proposed by Khandelwal et al. (2013). We hence do not use the disper- sion in export prices to proxy for vertical differentiation (Feenstra and Hanson, 2004; Bernard et al., 2015; Ahn et al.,2011) as a result of the well-known drawbacks in using unit values to proxy for quality (Hallak and Schott, 2011).

[11] The certification is granted by the China National Accreditation Board for Laboratorie.

[12] The website (http://www.shsilk.com.cn/about/subcmp1.aspx) also claims that the price of each process is lower than that of third-party service suppliers.

[13] We check that the measured link between reliance on specialized intermediaries and quality dispersion does not only reflect the efficacy of specialized intermediaries in improving quality. We also ensure that our results are not driven by the activities of affiliates established by foreign and domestic groups, whose raison d'^etre differs from the independent quality-screening role suggested by our theory.

quality levels. Exports by generalized intermediaries are shown to be of lower quality than those of specialized intermediaries, with the latter's quality being close to, but less than, that of direct exporters. This is consistent with the price results in the growing literature on trade intermediation, suggesting that intermediaries help relatively less efficient (low-quality) firms to export (Akerman, 2017; Bernard, Jensen, Redding, and Schott, 2010a; Ahn et al., 2011; Crozet, Lalanne, and Poncet, 2013). We also find a monotonic relationship between the degree of specialization of specialized intermediaries and the quality of the products sold. The quality of the products exported by specialized intermediaries in the upper quartile of the distribution of product range is higher than that of direct exporters.

Our analysis of the association between the use of trade intermediaries and product quality exploits city-level data and calculates measures of vertical differentiation at the city–product level. We hence depart from the traditional use of cross-sectional data across products, which overlook the spatial heterogeneity in quality dispersion. Our data reveal substantial variation in quality dispersion across Chinese cities, even for fairly homogeneous goods. We uncover a rather intuitive spatial component of quality dispersion: more open and accessible cities tend to have greater product-quality dispersion. However, the quality differentiation across Chinese intermediaries within a product is not only geographical and differs across products. We find that cities with a reputation for being high-quality centers for particular products have higher average quality and lower quality dispersion in these products. We also consistently observe a smaller coefficient of variation of quality dispersion across exporting cities for homogeneous products compared with differentiated products. This suggests that the city– product-, as opposed to product-level dimension, is the most appropriate for the analysis of quality dispersion. Using city–product data also allows us to include product fixed effects to address any confounding factors in the link between product-level quality heterogeneity and intermediation. Average price and quality, as well as the scope for vertical differentiation at the product level, are likely to be correlated with many other unobserved characteristics of our HS6 products (6-digit Harmonized System of classification of products), which may in turn determine the relative importance of intermediaries in exports. Our empirical approach controls for unobserved product-specific and city-specific characteristics via product- and city-level fixed effects. In our robustness checks we estimate panel regressions and confirm the existence of selection into the use of intermediaries, whereby exports in (city–product) industries with greater differences in quality across suppliers are more likely to be handled by specialized intermediaries. Our results here reconcile the contrasting existing results on the quality-verification role of intermediaries. As specialized intermediaries account for only a minority of intermediated trade, it is unsurprising that their quality-verification role is masked in aggregate data. The contrasting finding of quality-screening for traders in Hong Kong who export Chinese products are consistent with a greater proportion of these intermediaries being specialized (Feenstra and Hanson, 2004).

The remainder of the paper is structured as follows. Section 2 discusses intermediary heterogeneity and describes how we distinguish specialized from generalized intermediaries. Section 3 describes the construction of the quality variables and provides preliminary evidence of the quality-verification role of specialized intermediaries. Section 4 then presents the regression results linking trade intermediation to vertical differentiation, and Section 5 considers the difference in quality levels between our two types of intermediaries. Last, Section 6 concludes.

II. Heterogeneity among Intermediaries in China

A. Data

Our main data comes from the Chinese Customs Trade Statistics (CCTS) database, as used by Ahn et al. (2011) and Tang and Zhang (2012). This is compiled by the General Administration of Custom of China, and includes firm-level export values and quantities at the 8-digit HS product level by country of destination. For each individual export flow, we have both the quantity exported and the corresponding free on board (f.o.b.) value in U.S. dollars. We can then calculate the unit value of exports for each firm, product, and destination. The database also records the destination of exports and contains firm-specific information such as ownership (foreign, state or private), name and address. We collapse the data to the annual level and aggregate product data to the 6-digit HS level.

We adopt the common practice in the literature of identifying intermediary firms based on the Chinese characters that have the English equivalent meaning of “importer,” “exporter,” and/or “trading” in the firm’s name (Ahn et al., 2011; Tang and Zhang, 2012). In particular, we follow the approach in Tang and Zhang (2012) and search for the following pinyin (Romanized Chinese) phrases: “jin4chu1-kou3,” “jing1mao4,” “mao4yi4,” “ke1mao4,” “wai4jing1,” “wai4mao4,” and “gong1mao4.”[14]

[14] These last two terms, which mean “foreign trade” and “industry and trade” respectively, were not considered by Ahn et al. (2011). In the robustness tests in Table A5 we check that our results continue to hold with this more conservative measure.

B. Measuring specialization

We would like to differentiate between intermediaries that export a variety of products spanning unrelated sectors and those with a core competence in a single line of business. The former correspond to the type of traders that appear in the empirical literature, where intermediaries have consistently been found to export more products to more destination markets and more varieties per country than direct firms (Ahn et al., 2011; Bernard et al., 2010a; Crozet et al., 2013). This aspect of trading firms suggests that part of the role of intermediaries is to help firms send products to destination markets. On the contrary, intermediaries with a restricted core competence, which we will refer to as specialized traders, conform to the image of intermediaries in Dasgupta and Mondria (2012): they screen product quality and then reveal this to consumers.

We will distinguish between the two types of intermediaries according to their distribution of export sales over products: we calculate for each intermediary firm f the share of exports in each product p, s_f^p. We then compute the firm's Herfindahl index by aggregating the squares of the shares of all the products exported by firm f: [15]

$$HI_f = \sum_{p \in s_f} (s_f^p)^2 , \qquad (1)$$

where S_f is the set of (N_f) products that firm f exports, and s_f^p is the export-value share of product p over the total export value of firm f. A higher value of HI_f means that the firm's export basket spans a narrower range of varieties. Firm-level product scope is expected to rise with firm size and productivity (Bernard et al., 2010a; Bernard, Redding, and Schott, 2011). To control for those mechanical associations in our analysis of the heterogeneity of product concentration across intermediaries, we regress the HI measure on a quadratic polynomial in firm size (proxied by export value) with fixed effects for ownership,[16] and then take the residual, $\in HI_f$.

[15] We do not normalize the Herfindahl index (using $1 - 1/N_f$ in the denominator), as this would mechanically eliminate.

[16] We use three ownership-type dummies (state-owned enterprises, private firms, and foreign-invested firms) to pick up the well-documented productivity differences between firms by ownership (Bloningen and Ma, 2010). The online Appendix (for access details see Supporting Information at the end of this paper) shows that our results continue to hold when we distinguish specialized and generalized intermediaries using the ordinary Herfindahl index (without adjusting for size and ownership).

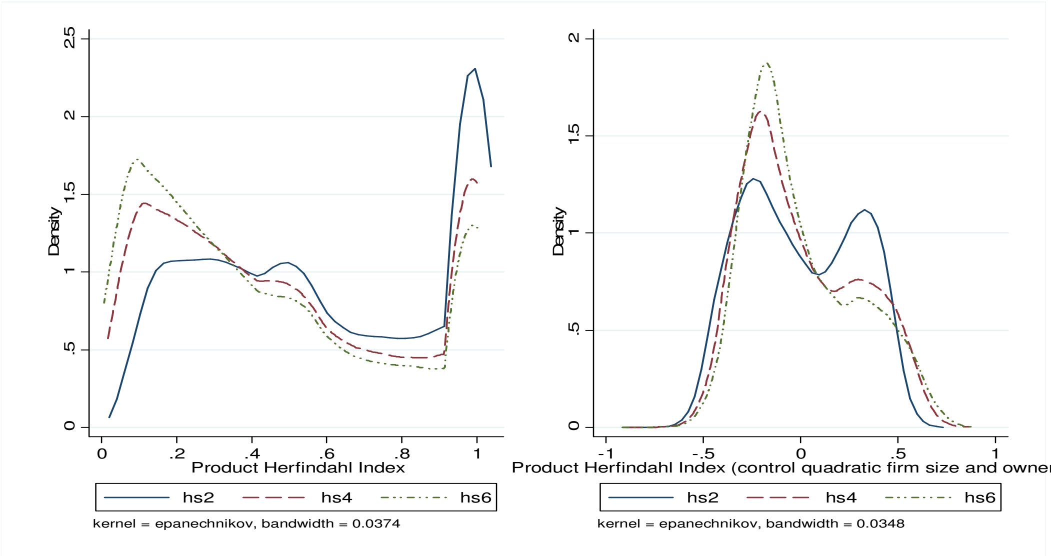

Figure 1 The distribution of firm-level Herfindahl indices

Note. The Herfindahl indices are calculated using Equation 1 with products p defined at the HS6, HS4, and HS2 levels. The right-hand panel shows the distribution of the Herfindahl indices after conditioning on a quadratic in firm size and firm-ownership dummies. See the text. In the left-hand panel, the mean, median, and standard deviation are 0.44, 0.36, and 0.33, respectively, when products are defined at the HS6 level, 0.49, 0.43, and 0.33 at the HS4 level, and 0.60, 0.56, and 0.32 at the HS2 level. In the right-hand side panel, the mean, median, and standard deviation are 0.01, 20.07, and 0.29, respectively, when products are defined at the HS6 level, 0.01, 20.06, and 0.29 at the HS4 level, and 0.01, 20.02, and 0.29 at the HS2 level.

Figure 1 shows the distribution of HI_f (left panel) and $\in HI_f$ (right panel) in our sample of intermediaries. The Herfindahl indices are calculated as the sums of product shares S_f^p defining the different products p at the HS6, HS4, and HS2 levels. The twin peaks in the figure suggest a bimodal distribution.

Two separate groups of intermediaries stand out: that to the right is characterized by a narrow range of products (i.e., specialized intermediaries) while that to the left covers a larger product range, which we refer to as generalized intermediaries.[17]

Our baseline distinction between specialized and generalized intermediaries is based on Figure 1, and in particular on the median value of $\in HI_f$. The intermediaries with HS6-product concentration (conditional on size and ownership) above the median are defined as specialized; those below the median are generalized. We will later check that our results are robust to replacing the median cutoff of product concentration by the 60th percentile, excluding mono-exporters and defining the p products in Equation 1 at a more aggregate (HS4 or HS2)

[17] Figure OA1 in the online Appendix shows that this bimodal distribution is robust to the exclusion of firms that export a single HS6 product.

level. It is important to point out that none of the criteria we use to delineate specialized- versus generalized-intermediaries automatically imply a mechanical correlation with average quality.

C. Summary statistics

Table 1 shows the overall export values for direct exporters and the two types of intermediaries. In 2005, intermediaries accounted for 21.2 percent of Chinese exports, with 8.7 percent of exports being handled by specialized intermediaries. This proportion is the same regardless of the aggregation level used to define the p products in the firm-level concentration indices. While the share of exports accounted for by intermediaries has fallen over time, the share of exports accounted by specialized intermediaries has remained constant at 9 percent.

Table 1 Summary statistics: The role of intermediaries

Year	Total export value (U.S.$ million)	Share in export value (%)				
		Direct exporters	Indirect exporters	Specialized intermediary		
				HS6	HS4	HS2
	(1)	(2)	(3)	(4)	(5)	(6)
2002	325,324	72.5	27.5	9.0	8.3	8.4
2003	417,548	75.7	24.3	8.2	7.6	7.6
2004	593,644	77.4	22.6	8.8	8.3	8.3
2005	761,484	78.8	21.2	8.7	8.1	8.1
2006	966,690	79.1	20.9	8.8	8.4	8.8

Notes: The definition of specialized- (generalized-) intermediaries is in terms of P. HHIf measured by HS6.

Source: Chinese customs and authors' calculations

Table 2 lists firm-level summary statistics in 2005 by firm type (direct exporters, generalized intermediaries and specialized intermediaries). As a small number of exceptionally large firms may dominate trade, we show both means and medians. The two intermediary types differ in a number of dimensions. With our differentiation between specialized and generalized intermediaries being based on the median, the two types account by construction for the same share of exporters (9.4 percent). However, as can be seen in row 2, generalized intermediaries are larger than specialized intermediaries, with median export sales of U.S. $864,283 and U.S. $598,946, respectively. Reflecting our use of product concentration to define generalized and specialized intermediaries, the median value of the number of HS6 products exported by the former is 25, more than six times that for the latter (4) and that of the median direct exporter (3). Generalized intermediaries also export to many more markets (8), as compared with the other two firm types (3). Row 3 follows Ahn et al. (2011) and classifies HS codes into one of 15 unrelated sectors[18] to identify the firm's core activity (e.g., animal products, wood products or textiles). The observation in Ahn et al. (2011) that intermediary firms (as a whole) handle products that span entirely unrelated sectors holds only for generalized intermediaries. The median generalized intermediary exports products in six sectors; on the contrary, the two other firm types, direct exporters and specialized intermediaries, only export products in one or two sectors. This is consistent with our description of specialized intermediaries as not only exporting fewer products, but also having a core competence.[19]

Table A1 displays the list of the top 20 products by export value of the HS6 categories with specialized intermediary share of over 50 percent. Table A2 carries out the same exercise for generalized intermediary shares. Intermediation by specialized intermediaries appears to be especially prevalent for tobacco products, maize, and coal and steel products where they can account for more than two-thirds of total exports. By contrast the share of generalized intermediaries never exceeds 67 percent. The largest shares are exhibited for a variety of textile fabrics. Table A1 hence points to tobacco and cigarettes as outliers on the right tail of the distribution of specialized intermediary export shares, possibly because trading these products through specialized intermediaries is less related to quality verification than to monopoly distribution rights. We will show that our empirical results are robust to dropping these two products.

[18] HS 01–05 "Animal and Animal Products;" HS 06–15 "Vegetable Products;" HS 16–24 "Foodstuffs;" HS 25–27 "Min- eral Products;" HS 28–38 "Plastics/Rubbers;" HS 41–43 "Raw Hides, Skins, Leathers and Furs;" HS 44–49 "Wood and Wood Products;" HS 50–63 "Textile;" HS 64–67 "Footwear/Headgear;" HS 68–71 "Stone/Glass;" HS 72–83 "Metals;" HS 84–5 "Machinery/Electrical;" HS 86–89 "Transportation;" HS 90–97 "Miscellaneous;" and HS 98–99 "Service."

[19] This echoes the emerging theoretical work that introduces core competencies in models of multiple-product firms (Eckel and Neary, 2010; Bernard, Redding, and Schott, 2010b).

Table 2. Firm-level summary statistics for exporting firms, 2005

Firm type	Direct firms		Generalized-intermediaries		Specialized-intermediaries	
	mean	median	mean	median	mean	median
Export value by firm (U.S. $thousands)	5.109	539	5.335	864	6,602	599
Export value by variety (HS6) by firm (U.S.$)	994,198	44,433	58,306	9,763	629,690	26,580
No. of markets	6.84	3	17.21	8	8.98	3
No. of industries (combined HS2)	1.99	1	6.78	6	3.03	2
No. of industries (HS2)	2.91	2	15.79	10	4.85	2
No. of industries (HS4)	5.68	2	44.26	18	9.63	3
No. of varieties (HS6)	8.66	3	70.83	25	14.21	4
Number of firms	116,375		13,414		13,413	

Note. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on the residual of a regression of the Herfindahl index on a quadratic in firm exports and firm ownership dummies (Equation 1), with products defined at the HS6 level.

Source. Authors' calculations from Chinese transactions data in 2005.

III. Intermediaries and Quality

Our proposition is that the vertical differentiation of a product determines the prevalence of specialized intermediaries that operate as quality-control agents. We hence expect specialized intermediaries to effectively verify quality and export at higher qualities than generalized intermediaries.

A. Quality differences between firm types

We build on the strategy of Khandelwal, Schott, and Wei (2013) to estimate the quality of a variety, which is defined as a specific good sold by a firm in a given destination. The two main elements are that (1) quality is assumed to play the role of a demand shifter, and (2) preferences are assumed to be CES across producers of imperfectly substitutable varieties. Identification is based on the following demand equation:

$$q_{fpc} = p_{fpc}^{-\sigma_p} \Lambda_{fpc}^{1-\sigma_p} P_{fpc}^{\sigma_p - 1} Y_{pc} \qquad (2)$$

where σ_p is the elasticity of substitution between varieties. Equation 2 shows the demand q_{fpc} addressed to each single producer f as a function of the price p_{fpc} relative to the price index P_{pc}, the quality of its variety Λ_{fpc} and the real demand in market *c*, Y_{pc} / P_{pc}.

After log-linearizing, the quality of each variety can be estimated as the residual from a demand equation, controlling for prices at the individual and aggregate level and the nominal demand in the market:

$$\ln q_{fpc} + \sigma_p \ln p_{fpc} = \underbrace{(\sigma_p - 1)\ln P_{pc} + \ln Y_{pc}}_{\text{Component specific to pc}} + \underbrace{(\sigma_p - 1)\ln \Lambda_{fpc}}_{\text{residual}} \qquad (3)$$

Since price indices and demands are not observed at the product and destination level, the standard approach pioneered by Khandelwal et al. (2013) is to capture these variables by fixed effects. We thus use the prices p and quantities q observed at the variety (p, c) level and a calibration of the elasticity of substitution σ_p to measure the left-hand side of Equation 3. Our data for σ_p are taken from Broda and Weinstein (2006).[20] We then regress this variable on country–product-level fixed effects. We rescale the estimated residual to reflect the heterogeneity in product-level elasticities of substitution to obtain an estimate of $\ln \Lambda_{fpc}$.

Figure 2 compares average product quality across firm types (direct exporters and generalized and specialized intermediaries). Exports by generalized intermediaries are shown to be of lower quality than those of specialized intermediaries, with the latter's quality being closer to, but less than, that of direct exporters.

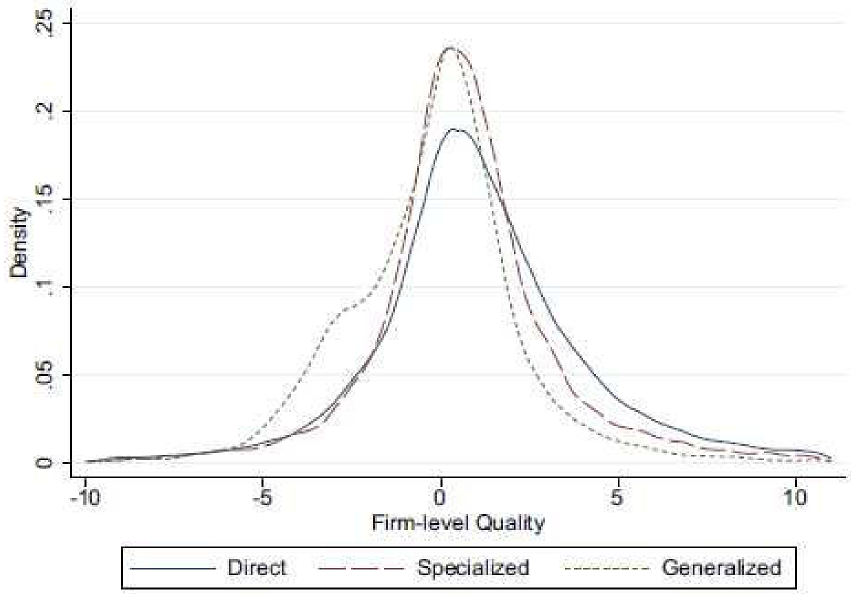

Figure 2 Distribution of firm-level quality (trimming 1%)

Note. The firm average is calculated as a weighted average using the share of the transaction (product–country) in the firm's exports

20 HS3 elasticities for China are taken from http://www.columbia.edu/dew35/TradeElasticities/TradeElasticities.html

Table 3 provides additional statistics on quality differences by firm type. Column 6 shows weighted average export quality when the weights are the shares of firm exports in the total exports of the firm type. Average quality for direct exporters is six times that of intermediaries, which is consistent with intermediaries helping relatively inefficient firms, those with low-quality products to export (Akerman, 2017; Bernard et al., 2010a; Ahn et al., 2011; Crozet et al., 2013). Nevertheless, export quality is higher for specialized than generalized intermediaries, with weighted average figures of 0.42 and 0.28 respectively. These statistics clearly suggest that specialized intermediaries focus on higher quality products.

Table 3 Summary statistics on export quality by firm type, 2005

	Firm-level quality					
	(1)	(2)	(3)	(4)	(5)	(6)
	Mean	Median	Mean	Median	Mean	Median
Firm type	1.37	0.9	20.59	2.78	7.36	2.5
Direct firms	0.79	0.55	20.6	1.85	4.86	0.42
Specialized intermediaries	20.17	20.01	21.62	1.11	3.32	0.28
Generalized intermediaries	1.37	0.9	20.59	2.78	7.36	2.5

Note. SD, standard deviation. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on the residual of a regression of the Herfindahl index on a quadratic in firm exports and firm ownership dummies (Equation 1), with products defined at the HS6 level. Firm-level quality is calculated as a weighted average with the share of the firm–product–country exports in firm total exports as the weights. The weights used in column (6) are firm total exports as a percentage of the total exports for the corresponding firm type (direct exporter, generalized intermediary and specialized intermediary).
Source. Authors' calculations from Chinese transactions data in 2005.

Table 4 shows the export share of high-tech products across different firm types (direct exporters and generalized and specialized intermediaries). Three complementary classifications are used to assess the technological content of the export basket of the three firm types. We report successively the simple share (using product lines) and the export weighted share of high-tech products. The first row uses the OECD classification, which provides a comprehensive and detailed list of the most technology intensive products (Hatzichronoglou, 1997). The classification is based on the R&D intensity, whether direct or indirect, of each product. Row 2 relies on the UNCTAD skill and technology content of products[21] and row 3 turns to the Eurostat classification of high-tech manufacturing industries.[22] The technological content of the direct exporters' export basket is systematically higher than that of intermediaries.

[21] The data is available at http://www.tradesift.com/about-ts/productGroups/pg_unctadSkill.aspx
[22] http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:High-tech

This is in line with the evidence in Ahn et al. (2011) that Chinese exports by intermediaries are more expensive than direct exporters.[23] Compared with generalized intermediaries, specialized intermediaries export a slightly higher share of high-tech goods, which is consistent with the image of specialized intermediaries being niche players focused on upscale specialty products.

Table 4 Summary statistics on export quality by firm type, 2005

	Share of high tech products in exported value		
	Direct firms	Intermediaries	
Firm type		Generalized	Specialized
High-tech products (OECD)	30.14	5.17	10.56
High-skill and technology products (UNCTAD)	27.52	3.15	7.9
High-tech products (Eurostat)	34.76	15.2	20.98

Note. See the text for the definition of intermediary firms and the classification of technology-intensive products. Specialized and generalized intermediaries are identified based on the residual of a regression of the Herfindahl index on a quadratic in firm exports and firm ownership dummies (Equation 1), with products defined at the HS6 level.
Source. Authors' calculations from Chinese transactions data in 2005

One concern with the positive correlation between specialized intermediaries and high-quality exports is that large firms may establish an affiliated trading company.

These affiliated intermediaries are not the independent quality-screeners that our theory suggests. These arms of what are likely highly productive firms may cluster in the specialized category, providing an alternate explanation of the positive correlation between specialized intermediaries and high-quality exports.[24] We exploit information from the firm names to identify firms belonging to a group and find that these subsidiaries are not clustered in a particular category of intermediates, which reassures that affiliates do not blur our distinction between specialized and generalized intermediaries.[25] In the empirical section we will show that our results are robust to dropping the group-related firms for our two sets of findings, the association between quality dispersion and the prevalence of specialized intermediaries, and the

[23] This finding is in line with Ahn et al.'s (2011) modeling of intermediation as producing higher marginal costs of foreign distribution. In their setting, firms with relatively higher unit costs endogenously select intermediation.

[24] We thank an anonymous referee for pointing out this issue.

[25] In the online Appendix we set out our method to identify a total of 3,182 affiliated firms, of which 27 percent are interme- diaries: 418 are specialized intermediaries and 439 are generalized intermediaries. We use two complementary approaches. The first corresponds to the presence of the term "group" in the company type, reflecting that the exporter belongs to a group. During the commercial registration process a company will be allowed to include "group" in its name if it can pro- vide evidence of at least three affiliated companies established by its parent company. The second consists in identifying group-related firms based on the fact that they share the same "Chosen name" as another firm, which can be their parent or another affiliate of the same parent. We also report summary statistics that show the same main differences between the two intermediary types and the direct exporters when excluding or focusing on these group-related firms.

quality difference between intermediaries and direct exporters.

B. Quality dispersion in China

We exploit the variation in the scope for quality differentiation across products and space to see whether intermediaries, or a subset of them, mitigate adverse-selection problems by guaranteeing product quality. We will show that there is substantial heterogeneity in terms of quality differentiation (i.e., the dispersion of qualities) across Chinese cities for a given product. This heterogeneity determines the prevalence of export intermediaries and, more importantly, the importance of the role that specialized intermediaries play in overall intermediation.

Our estimates of quality differentiation follow Khandelwal (2010) by calculating quality dispersion for each city–product pair as the standard deviation of the estimated ln Kfpc across all (firm–product– destination) flows.[26] We use data for 2004, as our empirical strategy relates 2005 intermediary prevalence to the one-year lagged quality dispersion at the city–product level.

Our concentration on product–city-, as opposed to product-level, variation in quality dispersion reflects that quality dispersion varies across both space and products in our data. Table OA11 in the online Appendix (for access details see Supporting Information at the end of this paper) reveals substantial variation in quality dispersion across Chinese cities, even for fairly homogeneous goods (garlic and silicon). Following Khandelwal (2010), we treat quality dispersion as an exogenous product characteristic.

Our work however differs in that we also measure quality dispersion at the city level. What we call cities here correspond to the first administrative division of the 31 Chinese provinces.[27] Given China's large population and area, the 321 cities in our sample are anything but small. We further only retain city–product pairs with over 10 (firm–product–destination) export flows to ensure that there are enough observations for a reliable measure of quality dispersion.

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[26] In Section 4.2 we show that the results are robust to defining dispersion using the trimmed or untrimmed standard deviation, the full range (maximum minus minimum) and the inter-quartile range of qualities.

[27] China is divided into four municipalities (Beijing, Tianjin, Shanghai, and Chongqing) and 27 provinces, which are fur- ther divided into (four-digit) prefectures. As is common in the literature, we use the term city to refer to the whole pre- fecture, even though it includes both an urban and a rural part.

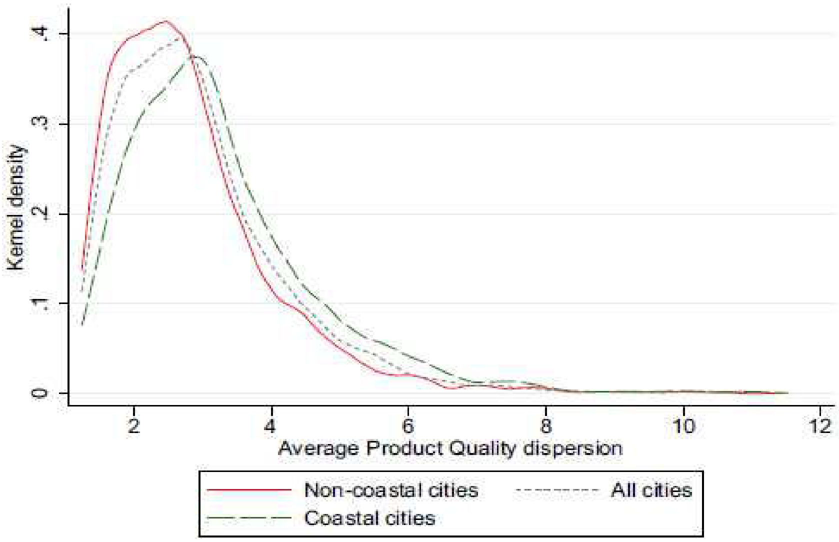

Figure 3 The distribution of average product quality dispersion, coastal versus noncoastal cities

Note. Product quality dispersion is defined as the standard deviation of quality in 2004. Average product quality dispersion is the mean of city–product quality dispersions across cities

Considering the link between product–quality differentiation and the share of intermediary exports at this level of spatial disaggregation, we may worry about the endogeneity of exporting-firm location across cities. While the diversity of firms in terms of export share may affect the measure of quality dispersion, which is calculated within a product across existing firms, it is unlikely to affect our measure of intermediary specialization, which is calculated across products within an exporting firm. Our empirical specification in any case controls for the number and diversity (as measured by the Herfindahl index) of intermediaries and direct exporters at the city–product level.

Figure 3 shows the dispersion of average quality separately for coastal and non-coastal cities. This figure highlights the spatial dispersion of quality, which varies across locations intuitively: more open and accessible cities tend to exhibit greater product-quality dispersion.

In the online Appendix we find a similar pattern with a more refined proxy of intrinsic openness: we calculate foreign-market access for each Chinese city in 2004 using the results from a gravity–trade regression, as in Redding and Venables (2004).[28] However, quality differentiation across Chinese intermediaries within a product is not only geographical, but also differs across products. For each product, we calculate the coefficient of variation (i.e., standard deviation divided by the mean) of quality dispersion across exporting cities. In Table OA12 in

[28] In the online Appendix we single out eight award-winning locations that were rewarded in 2002 by the China National Textile Industry Council for their unique development of industrial agglomeration bases. We consistently find that they have higher average quality and lower quality dispersion in the product in which they specialize.

the online Appendix we show the cross-product average and range of the coefficient of variation separately for homogeneous and differentiated products, following the definition in Rauch (1999). We obtain a smaller coefficient of variation for homogeneous than for differentiated products, suggesting that the product–city-, as opposed to product-level, dimension is the most appropriate for the analysis of quality dispersion.

IV. The Empirical Analysis of Intermediation

Our regression estimates the share of intermediary exports in city–HS6 observations, which is correlated with a proxy for the scope of vertical differentiation.

While firm-level customs data is available for 2000 to 2006, the Chinese system of trading licenses was not entirely dismantled until 2005. Following the literature, we consider the single year 2005 as the baseline as export licenses had been removed by 2005, and any firm that wished to trade directly with foreign partners was free to do so (Ahn et al., 2011). We show in the robustness checks in Subsection 4.2.2 that our results continue to hold in a panel specification appealing to variation over time in a given city–product pair of the relationship between quality dispersion and intermediary prevalence.

A. Empirical specification

We now formally examine how the prevalence of the two types of intermediary is related to vertical differentiation. Our specification is:

$$\text{Intermediary share}_{lp} = \beta \text{Quality Dispersion}_{lp} + \gamma Z_{lp} + \mu_l + \nu_p + \varepsilon_{lp} \tag{4}$$

where $\text{Intermediary share}_{lp}$ is the share of intermediary exports from Chinese city l in HS6 code p in 2005, and Quality Dispersion is quality heterogeneity across exports for that city–product pair. To address potential endogenous problems, we lag our proxy for quality differentiation by one year. Intermediary share will be further decomposed into those emanating from specialized and generalized intermediaries.

The regressions include both city fixed effects, μ_l, and HS6 fixed effects, ν_p. Product fixed effects capture inherent differences in the degree of intermediation that products require. These fixed effects also account for all of the intrinsic product factors, common to all Chinese locations, which may be correlated with both the scope for quality differences between firms and the prevalence of intermediaries. These include any repercussions from national-level trade protection of imports and exports, and the degrees of horizontal differentiation and contract dependence.[29]

City fixed effects control for location-specific characteristics that determine overall supply capacity, such as infrastructure, the technological level and factor endowments. Our empirical approach hence exploits both within-city variation across products and within-product variation across cities. For a given product we compare the prevalence of trade intermediation between cities where there is a relatively large quality heterogeneity among exporters with that in cities where there is less (after controlling for the city average via city fixed effects).

We further control for city–product characteristics. Chinese export performance varies considerably by firm ownership (Amiti and Freund, 2010). The inclusion of the share of exports by foreign firms and the share of state-owned firms defined at the city–product level is crucial to account for the ability of different cities to export different products without requiring intermediation, as a result of differences in firm-level productivity and quality reflecting different ownership structures.[30] Moreover the ownership structure of exporters is likely to have direct repercussions on the relative role of intermediaries and their specific type (specialized vs. generalized). State firms are generally less restricted in exporting directly than are private firms, since most of them have their own affiliated state-owned intermediaries to help them export. Foreign firms may also rely less on intermediaries, as they have better knowledge of export markets and may benefit from their parent company's distribution networks abroad. Meanwhile, foreign-invested enterprises do not require intermediaries to guarantee the quality of their products, as they primarily export for their parent companies in the destination countries.

Our set of controls Z_{lp} picks up the cost of using intermediaries and buyers' search costs. We include the Herfindahl index of intermediaries to control for inherent differences in the local monopoly power of intermediaries for a given product. This may relate to intangible assets such as an established reputation prior to trade liberalization. Following a similar logic we also include the Herfindahl index of direct exporters. We furthermore include the number of direct exporters and the number of intermediaries (in logs) to proxy for buyers' costs of searching for a producer and an intermediary respectively.

[29] Intermediaries have been shown to be less prevalent for freely traded products, contract-dependent products, and com- plex products (Ahn et al., 2011; Crozet et al., 2013; Tang and Zhang, 2012). The proxies used in these contributions such as the well-known Rauch (1999) classification for simple and complex goods or the measure of contract depend- ence in Nunn (2007) are calculated at the product level and will be reflected in the product fixed effects in our empiri- cal model.

[30] Foreign firms have higher productivity and product quality than do domestic firms in China (Ge, Lai, and Zhu, 2015). The superior performance of foreign affiliates typically derives from international technology spillovers (Keller and Yea- ple, 2009) and fewer financial constraints (Arnold and Javorcik, 2009; Manova et al., 2015).

The standard errors in all of the regressions are clustered at the city level to account for the correlation in the error terms across products for a given location (Moulton, 1990).[31] Our final sample consists of 51,233 observations spanning 3,042 HS6 products and 321 cities.

B. Results: intermediation and vertical differentiation

(1) Baseline results

Table 5 shows the estimates from Equation 4. In columns (1) and (2) the dependent variable is the share of intermediary exports. The coefficient on quality dispersion is negative and significant here, and is robust to the inclusion of the control variables discussed in Subsection 4.1. The results hence suggest that more vertically differentiated goods in China are less likely to be exported via intermediaries. Columns (3) and (4) reproduce column (2), with the dependent variable being respectively the share of specialized and generalized intermediaries in the exports of a city–product pair. Specialized and generalized intermediaries are distinguished as described in Section 2 using the median export Herfindahl (HS6 product concentration) indices.[32]

The estimated coefficients on the share of specialized and generalized intermediaries are positive and significant and negative and significant respectively. The overall negative association between prevalence and the heterogeneity of export qualities is thus driven by generalized intermediaries. The positive coefficient for specialized intermediaries suggests that their role is the exact reverse: the greater the heterogeneity of varieties produced, the more specialized intermediaries are used. This is consistent with the latter playing a quality-screening role, as product quality verification becomes more important with greater supplier heterogeneity. From the baseline estimates in column (3) of Table 5, one standard deviation rise in quality dispersion translates into a 0.6 percentage point specialized intermediaries' export share, which is a significant compared with the mean and median export figures of 12.3 and 2.3 percentage points respectively.

Columns (5) and (6) check that the positive correlation between specialized intermediation and quality dispersion is robust to controlling for other potential confounders. We could worry about reverse causality from the presence of specialized intermediaries and our quality-dispersion measure, resulting from the successful control of quality of the former.[33] If the specialized intermediaries in a location–product bin successfully screen quality, we should

31 Clustering standard errors at the product level does not change the significance of the coefficient.
32 In robustness checks in the online Appendix, we show that our results hold when differentiating specialized and gener- alized intermediaries based on the ordinary Herfindahl index (Equation 1) instead of the size–ownership adjusted Her- findahl residual, with the average firm size in the city–HS6 pair as an additional regressor.
33 We thank an anonymous referee for raising this issue.

have lower quality dispersion for this location–product pair in the data than the underlying dispersion in the absence of specialized intermediaries. Any such negative relationship would however counter a positive association between quality dispersion and the prevalence of specialized intermediaries. Our estimates thus represent a lower bound for the quality verification role of specialized intermediaries.

As an additional check we add the average quality of exports at the city–product level to the benchmark results to control for any correlation between the quality dispersion of local producers and its mean. Our hypothesis (which will be confirmed in Section 5) is that specialized intermediaries export higher quality products than do generalized intermediaries. We should thus control for the quality of product p exports in the city[34] when looking at the relationship between specialized intermediaries and local quality heterogeneity.

As shown in column (5) the quality level attracts a positive (albeit insignificant) coefficient, which is in line with our prior that specialized intermediaries focus on higher quality products. Controlling for the resulting higher quality of exported products does not however change the estimated effect of quality differentiation on the use of specialized intermediaries. In column (6) we further include city–HS2 fixed effects, so that we identify off of HS6 product variation within a given (HS2) industry within a city. This helps to ward off the criticism that certain cities might develop reputations for being high quality exporters in certain product groups (and that this is subsequently correlated with both the observed quality dispersion and the share of exports through specialized intermediaries).

Our overall finding is that separating by intermediary type suggests a role for quality screening by intermediates.[35] While intermediaries are overall found for less differentiated products, the evidence suggests a quality-checking role for specialized intermediaries, who are more likely to be present in exports with greater local quality differentiation. Our results are then consistent with selection into intermediary use, whereby exports in industries with substantial differences in quality across suppliers are disproportionately handled by specialized intermediaries. In absence of an independent variable (IV) or a quasi-natural experiment, we cannot entirely dispel the possibility of reverse causality but the body of evidence nevertheless is consistent with the "selection into intermediary use" view.

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[34] This is calculated as the weighted average of variety (firm–product–country) quality estimated in Equation (3) using the export share of the corresponding variety (firm–country) in city–product-level exports to calculate a weighted aver- age quality figure for a city–product pair.

[35] In Table OA7 in the online Appendix we check that the results continue to hold when using a fractional probit model to account for the 0 to 1 range of our dependent variable.

Table 5 Intermediation and quality differentiation: Baseline results

Dependent	Share in city–HS6 exports of					
	All intermediaries		Specialized intermediaries	Generalized intermediaries	Specialized intermediaries	
	(1)	(2)	(3)	(4)	(5)	(6)
Quality dispersion	-0.0016***	-0.0006**	0.0007***	-0.0013***	0.0006**	0.0005**
		(0.0005)	(0.0003)	(0.0002)	(0.0003)	(0.0002)
Foreign export share		-0.2688***	-0.0684***	-0.2005***	-0.0684***	-0.0803***
		(0.0109)	(0.0091)	(0.0079)	(0.009)	(0.0097)
State export share		-0.2710***	-0.1029***	-0.1681***	-0.1028***	-0.1091***
		(0.0121)	(0.0081)	(0.0097)	(0.0081)	(0.01)
Herfindahl of intermediaries		0.2486***	0.2217***	0.0269*	0.2217***	0.2117***
		(0.0091)	(0.0212)	(0.0162)	(0.0213)	(0.0214)
Herfindahl of direct exporters		-0.2503***	-0.0666***	-0.1837***	-0.0667***	-0.0644***
		(0.01)	(0.0068)	(0.0102)	(0.0067)	(0.0063)
Ln Number of intermediaries		0.1781***	0.0815***	0.0966***	0.0815***	0.0772***
		(0.0042)	(0.0041)	(0.0041)	(0.004)	
Ln Number of direct exporters		-0.1996***	-0.0538***	-0.1457***	-0.0539***	-0.0535***
		(0.0032)	(0.0031)	(0.0038)	(0.003)	(0.0031)
Ln Average export quality					0.0002	0.0001
					(0.0002)	(0.0002)
HS6–product fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
City fixed effects	Yes	Yes	Yes	Yes	Yes	n.a.
City–HS2 fixed effects	No	No	No	No	No	Yes
Observations	51,233	51,233	51,233	51,233	51,233	51,233
R^2	0.29	0.74	0.35	0.57	0.35	0.46

Note. Heteroskedasticity-robust standard errors clustered at the city level appear in parentheses. ***,**,* Denote significance at the 1%, 5%, and 10% confidence levels, respectively. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on the residual of a regression of the Herfindahl index on a quadratic in firm exports and firm ownership dummies (Equation 1), with products defined at the HS6 level.

Specialized intermediaries do not then seem to be subject to the hold-up problems in trade intermediation described in the literature (Felbermayr and Jung, 2011; Tang and Zhang, 2012): they instead appear to be an effective way for high-quality good producers to signal their quality to consumers.

One should probably add the disclaimer here that you cannot entirely dispel the possibility of reverse causality, since you do not have an IV or a quasi-natural experiment, but the body of evidence nevertheless is consistent with the "selection into intermediary use" view.

(2) Robustness checks

Table A3 in the Appendix checks that our main finding is robust to alternative ways of differentiating between the two intermediary types. In the first two columns the Herfindahl indices used to separate specialized from generalized intermediaries are calculated using HS4 and HS2 products respectively.

The resulting point estimates are not statistically different from those in our baseline results (column 3 in Table 5). In column (3), the median cutoff of product concentration is replaced by the 60th percentile, so that specialized intermediaries are a more elite group. The positive association between specialized intermediary export share and vertical differentiation continues to hold. In columns (4) to (6), we change the way in which quality dispersion is calculated. We first calculate the standard deviation of qualities after excluding extreme values. Column (4) uses the 1 percent trimmed standard deviation of qualities within a city–product pair, column (5) the inter-decile range, and column (6) a measure of quality dispersion defined as the difference between the maximum and minimum quality of varieties within a city–product. We continue to find that Chinese cities with greater quality dispersion rely more on specialized intermediaries for their exports.

Table A4 considers other types of outliers[46]. Column (1) excludes processing trade.[47] A growing literature has underscored the many ways in which processing and ordinary trade regimes differ. Processing exports are characterized by greater value added (Koopman, Wang, and Wei, 2012), more technological content and higher quality varieties than are ordinary

[46] In results in the online Appendix, we check that all of the results contained in Table A4 continue to hold when measuring quality dispersion using the inter-decile range. This is the measure used in Khandelwal (2010), as it is argued to be more robust to outliers.

[47] Processing trade refers to the operations of firms, most often foreign, that obtain raw materials or intermediate inputs from abroad and, after assembling them in China, re-export the value-added final products (Feenstra and Hanson, 2005). Operations in the assembly sector that import inputs to process them in China and re-export the final products accounted for 41 percent of China's trade between 2002 and 2012.

exports (Wang and Wei, 2010). We thus check that our finding of quality verification by specialized intermediaries in China does not simply reflect the particularities of processing exports. Foreign firms are excluded in column (2) so that all of the indicators are calculated using information only from domestic firms. Hong Kong plays a very specific role in intermediating trade between China and the rest of the world (Feenstra and Hanson, 2004). In column (3), the data set excludes exports to Hong Kong: our main result is robust to this exclusion. In column (4) we exclude the activities of firms belonging to a group to ensure that subsidiaries established by foreign and domestic groups do not affect our distinction between specialized and generalized intermediaries. Column (5) shows that our findings are robust to excluding tobacco and cigarettes, which Table A1 identified as outliers on the right tail of the distribution of specialized intermediary export shares. The point estimates are virtually unchanged.[48]

Table 6 turns to a panel specification, which controls for all time-invariant differences between HS6–city pairs, as well as a number of time-varying characteristics that may be correlated with both quality dispersion and intermediary use. We here use Chinese customs data from 2002 to 2006, [49] and hence appeal to the variation (over time) within a given city–product pair of the relationship between quality dispersion and intermediary prevalence. The use of pre-2005 is subject to caution, as the pre-2005 Chinese system of trading licenses de facto impeded some firms that wished to trade directly with foreign partners from doing so.

Our regressions include the three pairwise combinations of fixed effects: city–product, city–year and product–year. Besides city–product fixed effects, we include time-varying city-level dummies to account for demand and supply shocks that are common to all products in a given city and year as well as product–year dummies to account for all factors that affect product-level exports irrespective of the city of origin in a given year. In the last two columns (3 and 4) we add city–HS2–year fixed effects, and so consider variation between HS6 products within a given (HS2) industry for a given city–year. Columns (2) and (4) further include the

[48] We propose other robustness checks in results in the online Appendix. We exclude the top and bottom 5 percent of city–product pairs in terms of quality differentiation. We exclude mono-product firms: this helps to address the concern that the bi-modal distribution of intermediaries observed in Section 2 is only picking up the difference between mono- and multi-product exporters. We also consider specific product features by dropping observations on products that are known to be clearly different from others. We exclude products for which some restrictions (mostly licenses and quo- tas) remained in place after China's entry to the WTO. The list is taken from https://www.wto.org/english/thewto_e/ acc_e/completeacc_e.htm. Although all restrictions had been removed by 2005, we may suspect that these products are different from the others. Last we exclude homogeneous products (defined using the classification in Rauch [1999]), for which producers are more likely to resort to intermediaries (Ahn et al., 2011; Crozet et al., 2013). None of these changes has any impact on our results.

[49] The rationale for starting in 2002 relates to the change in trade restrictions following China's WTO accession and the change in product nomenclature between 2001 and 2002. 2006 is the last year for which firm-level customs data is available.

average quality of exports at the city–product–year level to control for any correlation between the quality dispersion of local producers and its mean in that year. The quality level typically attracts a positive (albeit insignificant in column 4) coefficient, which is in line with our prior that specialized intermediaries focus on higher quality products. Controlling for the resulting higher quality of exported products however does not change the estimated effect of quality differentiation on the use of specialized intermediaries.

Table 6 Specialized intermediaries and quality differentiation: Panel estimates

Dependent	Share in city–HS6 exports of specialized intermediaries			
	Years 2002–2006			
	(1)	(2)	(3)	(4)
Quality dispersion	0.00041**	0.00040*	0.00035*	0.00035*
	(0.0002)	(0.00021)	(0.00018)	(0.00018)
Foreign export share	20.084***	20.084***	20.084***	20.084***
	(0.007)	(0.007)	(0.007)	(0.007)
State export share	20.113***	20.113***	20.111***	20.111***
	(0.011)	(0.011)	(0.012)	(0.012)
Herfindahl of intermediaries	0.081***	0.081***	0.078***	0.078***
	(0.006)	(0.006)	(0.006)	(0.006)
Herfindahl of direct exporters	20.041***	20.041***	20.040***	20.040***
	(0.004)	(0.004)	(0.004)	(0.004)
Ln Number of intermediaries	0.041***	0.041***	0.039***	0.039***
	(0.002)	(0.002)	(0.002)	(0.002)
Ln Number of direct exporters	20.033***	20.033***	20.030***	20.030***
	(0.002)	(0.002)	(0.002)	(0.002)
Ln Average export quality		0.00031*		0.00025
		(0.00018)		(0.00018)
City–HS6 product fixed effects	Yes	Yes	Yes	Yes
HS6 product–year fixed effects	Yes	Yes	Yes	Yes
City–year fixed effects	Yes	Yes	n.a.	n.a.
City–HS2–year fixed effects	No	No	Yes	Yes
Observations	162,350	162,350	162,350	162,350
R2	0.79	0.79	0.82	0.82

Note. Heteroskedasticity-robust standard errors clustered at the city level appear in parentheses. ***,**,* Denote significance at the 1%, 5%, and 10% confidence levels, respectively. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on the residual of a regression of the Herfindahl index on a quadratic in firm exports and firm ownership dummies (Equation 1), with products defined at the HS6 level. Source. Authors' calculations from Chinese transactions data in 2002–2006.

Our results using the panel dataset are hence fully consistent with our baseline results for 2005. Intermediation is more prevalent for less vertically differentiated products, with the opposite pattern for a subset of intermediaries, specialized traders: they are more present in exports with greater differences in quality across local suppliers, suggesting that they help to check or screen product quality for buyers.

C. Accounting for the destination country

Our empirical strategy has so far mostly exploited variations in the need to screen quality by the source of the exports. The capacity of buyers to deal with information asymmetry and identify the quality of Chinese exports also depends on their nationality. Buyers may better be able to verify the quality of their imports if they are not too far away from and share linguistic and cultural ties with China. By way of contrast fixed export costs or import tariffs imposed by the destination country are not expected to affect the difficulty of quality assessment. Table 7 shows the moderating role of country characteristics in the correlation between the intermediation export share and vertical differentiation. The dependent variable is the share of intermediary exports in city–product– country observations in 2005. The key parameter of interest is the interaction between our quality-dispersion measure for a city–product pair and proxies for information asymmetries between China and the destination country. Fixed effects at the city–product, city–country and product–country levels are introduced.

The first three columns introduce bilateral variables to capture the particular links between China and its partner countries: distance [50] and the share of ethnic Chinese population in 1990 and 1980 respectively.[51] Column (4) considers the sunk cost of exporting to a partner as measured by the number of import procedures in the World Bank's Doing Business Report (Djankov et al., 2006), while column (5) uses the tariff imposed by the partner.[52] Our findings are fairly intuitive. The link between specialized intermediary prevalence and quality differentiation is stronger for more distant exports and falls when the destination country has more ethnic Chinese. By way of contrast, our proxies of fixed trade costs and the tariffs imposed on Chinese exports at destination do not affect the quality-verification role. This is

[50] We use GeoDist dataset (Mayer and Zignago, 2011), available at http://www.cepii.fr/francgraph/bdd/distances.htm

[51] See Poston, Mao, and Yu (1994) and Poston and Yu (1990), available at http://data.worldbank.org/indicator/IC.IMP. DOCS?page52

[52] The product-level tariff applied to Chinese goods in 2004 is taken from http://wits.worldbank.org/

consistent with a need for quality checking that falls with mutual understanding and rises with information dissonance.

Table 7 Specialized intermediaries and quality differentiation: The country-dimension

Dependent variable	Share in city–HS6–country exports of specialized intermediaries				
	(1)	(2)	(3)	(4)	(5)
Quality dispersion X Ln distance	0.00037*				
	(0.00019)				
Quality dispersion X Ln (share ethnic Chinese 1990)		-0.00018***			
		(0.000068)			
Quality dispersion X Ln (share ethnic Chinese 1980)			-0.00020**		
			(0.000075)		
Quality dispersion X No. of importing documents				0.00004	
				(0.00006)	
Quality dispersion X Tariff rate					0.00002
					(0.00002)
City–HS6 product fixed effects	Yes	Yes	Yes	Yes	Yes
Country–HS6 product fixed effects	Yes	Yes	Yes	Yes	Yes
City–country fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	1,109,593	773,139	761,584	1,052,115	943,522
R^2	0.43	0.42	0.42	0.43	0.42

Note. Heteroskedasticity-robust standard errors clustered at the country level appear in parentheses. ***,**,* Denote significance at the 1%, 5%, and 10% confidence levels, respectively. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on the residual of a regression of the Herfindahl index on a quadratic in firm exports and firm ownership dummies (Equation 1), with products defined at the HS6 level.

Source. Authors' calculations from Chinese transactions data in 2005.

V. Empirical Results: Intermediation and Quality

We now ask whether there is a "quality premium" for specialized relative to generalized intermediaries. We compare the qualities of the products exported by generalized and specialized intermediaries and direct exporters on each market. If specialized intermediaries do indeed screen quality and select the best goods, we expect their measured quality to be higher than that of generalized intermediaries, although this quality could be lower than that of direct exporters. Furthermore if the specialization of intermediaries in a restricted core competence produces greater incentives to be a reliable supplier of quality goods, there should be a monotonic relationship between the percentile cutoff used to discriminate specialized intermediaries and the quality of the products sold. We anticipate that the quality of goods exported will rise with the cutoff of the product scope distribution used to identify specialized intermediaries.

Our empirical approach is to regress our estimates of firm export quality in 2005, $\ln \Lambda_{fpc}$, at the product and country level on dummies for specialized and generalized intermediaries, as described in Section 2. The omitted category is direct exporters. Our regressions include product–country fixed effects and city–product fixed effects to account for unobserved factors, including any systematic differences related to the homogeneity, relationship specificity and non-contractibility of products that may help determine intermediary use. We include firm export value (in logs) and its square to control for firm size (Ahn et al., 2011) as well as three ownership-type dummies (state-owned enterprises, private firms, and foreign-invested firms). Moulton (1990) shows that regressing individual variables on aggregate variables can produce downward-biased standard errors. We therefore cluster standard errors at the firm level in all regressions.

The results appear in Table 8. Column (1) considers the overall effect of intermediaries on quality, and column (2) splits the intermediary dummy into specialized and generalized dummies. Column (3) reproduces column (2) excluding the product–country pairs for which intermediaries make up under 1 percent or over 99 percent of exports, while column (4) excludes product–country pairs for which intermediaries make up under 5 percent or over 95 percent of exports. Export quality is significantly lower for goods that are handled by intermediaries. This is consistent with the growing literature suggesting that intermediaries systematically handle the exports of less efficient firms; those with lower quality products (Akerman, 2012; Bernard et al., 2010a; Ahn et al., 2011; Crozet et al., 2013). Column (2) suggests that this quality discount is mainly found for generalized intermediaries. The coefficient on quality for specialized intermediaries is insignificant. This hierarchy continues to hold when the sample is restricted to product–country pairs for which the intermediary share is strictly above 1 percent and below 99 percent (column 3) and for which the intermediary share is strictly above 5 percent and below 95 percent. The F-test at the foot of each column indicates that we can reject (at the 1 percent confidence level) the null hypothesis that the specialized and generalized intermediary coefficients are equal. Overall, our findings suggest a significant quality gap between specialized and generalized intermediaries. While the products handled by generalized intermediaries are of lower quality than those of direct exporters, the difference between specialized intermediaries and direct exporters is insignificant. This suggests quality screening by specialized intermediaries that enables them to select products of the same quality as those of direct exporters.

Table 8 Intermediation and export quality: Baseline results

Dependent variable	Firm quality of exports (product-country) in 2005: ln Λ_{fpc}			
Sample restriction			Intermediary share	
			>1% and <99%	>5% and <95%
	(1)	(2)	(3)	(4)
Intermediary	-0.623***			
	(0.046)			
Specialized intermediary		0.03	0.066	0.086
		(0.071)	(0.07)	(0.067)
Generalized intermediary		-0.778***	-0.763***	-0.733***
		(0.044)	(0.044)	(0.043)
Ln Firm export value	-0.135	-0.038	-0.018	-0.006
	(0.193)	(0.175)	(0.164)	(0.153)
Ln^2 (Firm export value)	0.012*	0.009	0.008	0.007
	(0.007)	(0.006)	(0.006)	(0.005)
Firm ownership dummies	Yes	Yes	Yes	Yes
HS6 product–country fixed effects	Yes	Yes	Yes	Yes
City–HS6 product fixed effects	Yes	Yes	Yes	Yes
Observations	4,102,589	4,102,589	3,982,977	3,811,140
R^2	0.23	0.23	0.23	0.23
F-test Bspec=Bgen		184.6	198	205.5
Proba>F		0.001	0.001	0.001

Note. Heteroskedasticity-robust standard errors clustered at the firm level appear in parentheses. ***,**,* Denote significance at the 1%, 5%, and 10% confidence levels, respectively. Firm quality, ln Kfpc, is calculated using Equation 3. Three ownership-type dummies (state-owned enterprises, private firms, and foreign-invested firms) are included. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on the residual of a regression of the Herfindahl index on a quadratic in firm exports and firm ownership dummies (Equation 1), with products defined at the HS6 level. Column 3 excludes product–country pairs for which intermediaries make up under 1% or over 99% of exports. Column 4 excludes product–country pairs for which intermediaries make up under 5% or over 95% of exports. The F-test shown at the foot of each column tests the equality of the estimated coefficients on the two intermediary types. The probabilities (below 0.01) indicate that this equality is rejected at the 1% confidence level.

Table A5 checks that our results are robust to different ways of defining specialized and generalized intermediaries. In column (1) we calculate Herfindahl indices at the HS4 instead of the HS6 level; in column (2) we use the even more aggregated HS2 level. Our result of lower quality for products being handled by generalized intermediaries does not change, while the difference between specialized intermediaries and direct exporters turns positive and significant. In column (3) we adopt the more conservative approach in Ahn et al. (2011) of identifying intermediary firms based on Chinese characters. Compared with our baseline measure we drop firms whose names include “foreign trade” or “industry and trade” as intermediaries. In column (4), we exclude firms that export a single HS6 product from our analysis to see whether the quality gap between specialized and generalized intermediaries is just reflecting a general difference between mono- and multi-product exporters. We continue to find lower quality for intermediaries that is entirely driven by generalized intermediaries: specialized intermediaries handle significantly higher quality goods than do generalized intermediaries. The export quality of specialized intermediaries is not statistically different from that of direct exporters.

Table A6 repeats our analysis for some specific samples. We repeat the regression of column (2) in Table 8 excluding foreign firms (column 1) and then group-related firms (column 2). In column (3) we remove products that obtained their trade license after 2001, and in column (4) homogeneous goods traded on an organized exchange, as defined by Rauch (1999). In column (5) we exclude tobacco and cigarettes, for which the specialized intermediary export shares are abnormally high, possibly owing to monopoly distribution rights. The negative quality premium for intermediaries, which is fully driven by generalized intermediaries, compared with direct exporters continues to hold.

In results available in the online Appendix (see Supporting Information at the end of this paper) we further ensure that our results are robust to a variety of tests related to the origin and destination of exports. We exclude the four cities with province status (Beijing, Tianjin, Shanghai, and Chongqing), which stand out by their greater political autonomy and smaller surface area. We also tackle China’s interior–coast divide. Coastal locations are significantly different from the rest of the country: they have more outward-oriented economies and have had great success in attracting foreign investment. The exclusion of export flows from coastal locations or inland locations does not affect our results. We also drop export flows to Hong Kong and to less-developed countries, as these may differ from the bulk of Chinese exports. In all cases, generalized intermediaries handle the lowest qualities with the export quality of specialized intermediaries being not statistically different from that of direct exporters.

As a final check on the robustness and consistency of our results based on the distinction between specialized and generalized intermediaries, Table 9 investigates the link between the degree of specialization of specialized intermediaries and the quality of their products. In the first two columns our baseline specialized intermediary dummy (based on the median) is split into various dummies depending on the range of varieties handled by the specialized intermediary. In column (1) we use a set of dummies to denote whether the specialized intermediary's Herfindahl (HS6 product concentration) index is in the 50th to 75th percentiles,

Table 9 Intermediation and export quality: The relationship between cut-off and quality

Dependent variable	Firm quality of exports (product-country) in 2005: $\ln \Lambda_{fpc}$					
	Herfindahl cut-off *c*					
	50th	50th	60th	70th	80th	90th
	(1)	(2)	(3)	(4)	(5)	(6)
Specialized intermediary(50th–75th)	-0.058					
	(0.079)					
Specialized intermediary (75th–90th)	0.390***					
	(0.100)					
Specialized intermediary (50th–60th)		-0.215***				
		(0.080)				
Specialized intermediary (60th–70th)		0.132				
		(0.111)				
Specialized intermediary (70th–80th)		0.409***				
		(0.122)				
Specialized intermediary (80th–90th)		0.418***				
		(0.106)				
Specialized intermediary (> 90th)	0.533***	0.539***				
	(0.144)	(0.144)				
Specialized intermediary (> cutoff c)			0.261***	0.417***	0.422***	0.464***
			(0.080)	(0.081)	(0.094)	(0.145)
Generalized intermediary(<=cutoff c)	-0.781***	-0.784***	-0.724***	-0.678***	-0.652***	-0.638***
	(0.044)	(0.044)	(0.045)	(0.046)	(0.046)	(0.046)
Ln Firm export value	-0.046	-0.033	-0.045	-0.126	-0.132	-0.136
	(0.179)	(0.179)	(0.18)	(0.195)	(0.195)	(0.194)
Ln2 (Firm export value)	0.009	0.009	0.009	0.012*	0.012*	0.012*
	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)
Firm ownership dummies	Yes	Yes	Yes	Yes	Yes	Yes
HS6–Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
City–HS6 product fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,102,589	4,102,589	4,102,589	4,102,589	4,102,589	4,102,589
R^2	0.23	0.23	0.23	0.23	0.23	0.23
F-test Bspec=Bgen	91.82	67.41	218.7	198.5	135.4	58.47
Proba>F	0.01	0.01	0.01	0.01	0.01	0.01

Note. Heteroskedasticity-robust standard errors clustered at the firm level appear in parentheses. ***,**,* Denote significance at the 1%, 5%, and 10% confidence levels, respectively. Three ownership-type dummies (state-owned enterprises, private firms, and foreign-invested firms) are included. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on the residual of a regression of the Herfindahl index on a quadratic in firm exports and firm ownership dum- mies (Equation 1), with products defined at the HS6 level using the cut-off -c indicated at the top of each column. The F-test shown at the foot of each column tests the equality of the estimated coefficients on the two intermediary types. The probabilities (below 0.01) indicate that this equality is rejected at the 1% confidence level.

in the 75th to 90th percentiles, or above the 90th percentile of the distribution of product concentration. The omitted category is the case where the Herfindahl is below the 50th percentile. In column (2), we use five dummies corresponding to the five above median deciles of the distribution of export sales over products.

We find that export quality is higher when the specialized intermediary's export basket spans a narrower range of varieties. The results in column (2) suggests a monotonic relationship between the distribution of product scope and the quality of the products sold, which is consistent with our prior that a restricted core competence produces greater incentives to be a reliable supplier of quality goods.

The remaining columns confirm this systematic link between the percentile cutoff used to identify specialized intermediaries and the quality of the products sold. The various columns reproduce column (2) of Table 8 using different product (Herfindahl) concentration cutoffs pre- sented in increasing order. Column (3) relies on the 60th percentile, a stricter threshold than the baseline that turns some intermediaries previously identified as specialized into generalized. This cutoff rises progressively from the 70th percentile in column (4) to the 90th percentile in column (6). The positive and significant coefficients on the dummies for intermediaries in the four top deciles of product concentration indicate that intermediaries with core competence in a single line of business export higher quality (price) products compared with direct exporters. This subset of intermediaries hence does not conform to the traditional conception of intermediaries systematically handling the exports of less-efficient, low-quality firms.

VI. Conclusion

This paper has contributed to the analysis of export intermediary firms. We use Chinese firm-level customs data to show that separating generalized from specialized intermediaries is key to understanding the quality-screening role played by intermediaries in international trade. We show that specialized and generalized intermediaries differ in that the former are more prevalent when there is a greater degree of quality differentiation, that is, where quality verification would seem to be the most needed. Our results suggest selection into intermediary use based on the intrinsic features of the product being traded. Consistent with specialized intermediaries reducing quality problems, we find that their export quality is higher than that of generalized intermediaries. Our results suggest a consistent sorting into export markets, whereby higher quality producers export directly and specialized intermediaries help buyers to screen quality and avoid quality problems among the remaining varieties.

Appendix

Table A1 Top 20 HS6 products by export values with highest specialized intermediary shares, 2005

HS6 code	Product description	Specialized intermediary export share (%)	Intermediary export share a(%)	Share in total exports (%)
240120	Tobacco, partly/wholly stemmed/stripped	98.62	99.76	0.03
240220	Cigarettes cont. tobacco	97.84	98.53	0.03
100590	Maize (corn), other than seed	74.46	75.03	0.15
720838	Flat-rolled prods. of iron/non-alloy steel,	71.02	71.11	0.08
270111	Anthracite coal, whether or not pulverized	70.11	70.2	0.06
720837	Flat-rolled prods. of iron/nonalloy steel	68.79	68.89	0.06
030192	Live eels (Anguilla spp.)	67.59	73.09	0.02
261310	Molybdenum ores and concs., roasted	64.42	64.43	0.15
720230	Ferro-silico-manganese, in granular/powder	63	65.96	0.03
270112	Bituminous coal, whether or not pulverized	62.6	62.6	0.48
252310	Cement clinkers	59.32	60.5	0.04
640590	Footwear other than with uppers of leather	58.24	70	0.09
283620	Disodium carbonate	57.02	57.52	0.04
282530	Vanadium oxides and hydroxides	56.1	57.7	0.03
851632	Electro-thermic hair-dressing app.	55.16	67.23	0.03
360410	Fireworks	53.6	63.73	0.05
721933	Flat-rolled prods. of stainless steel	53.23	53.83	0.03
310530	Diammonium phosphate	51.07	51.7	0.03
720836	Flat-rolled prods. of iron/nonalloy steel	50.88	50.91	0.03
902830	Electricity meters	50.03	61.92	0.03

Source. Authors' calculations from Chinese transactions data in 2005.

Table A2 Top 20 HS6 products by export values with highest generalized intermediary shares, 2005

HS6 code	Product description	Generalized intermediary export share (%)	Intermediary export share (%)	Share in total exports (%)
551522	Woven fabrics of acrylic staple fibres	66.87	72.68	0.01
520526	Cotton yarn, single (excl. sewing thread)	66.6	69.83	0.01
521119	Woven fabrics of cotton	63.91	69.85	0.01
844900	Machinery for the mfr of felt/nonwovens	63.13	80.16	0.01
262190	Slag and ash, incl. seaweed ash (kelp)	62.25	71.13	0.01
410621	Tanned/crust hides and skins of goats/kids	61.41	88.52	0.01
630319	Curtains (incl. drapes) and interior blinds	59.33	65.99	0.01
400700	Vulcanized rubber thread and cord	59.18	67.66	0.01
580230	Tufted textile fabrics	59.16	67.06	0.01
847930	Presses for the mfr of board of wood	57.07	71.94	0.01
845320	Machinery for making/repairing footwear	56.2	64.7	0.01
551599	Woven fabrics of synth. staple fibres	55.97	69.04	0.01
521159	Woven fabrics of cotton	53.14	62.89	0.01
580123	Weft pile fabrics other than uncut of cotton	52.57	57.4	0.01
820540	Screwdrivers	52.21	60.06	0.02
020732	Meat of ducks/geese/guinea fowls, not cut	51.79	66.1	0.01
620323	Men's/boys' ensembles of synth. fibres	51.52	57.11	0.01
551693	Woven fabrics of art. staple fibres	51.48	65.68	0.01
300410	Medicaments cont. penicillins/derivs.	51.4	66.51	0.01
551322	Woven fabrics of polyester staple fibres	50.57	57.58	0.01

Source. Authors' calculations from Chinese transactions data in 2005.

Table A3 Specialized intermediaries and quality differentiation: Indicator checks

Dependent variable	Share in city–HS6 exports of specialized intermediaries					
	Herfindahl cut-off			Dispersion measure		
	Median HS4	Median HS2	60th HS6	SD 1st–99th	Inter-decile range	Max–min range
Quality dispersion	0.0006**	0.0005**	0.0006**	0.0007***	0.0002**	0.0001*
	(0.0003)	(0.0003)	(0.0003)	(0.0002)	(0.0001)	(0.00005)
Foreign export share	-0.0586***	-0.0525***	-0.0322***	-0.0684***	-0.0682***	-0.0682***
	(0.0077)	(0.0066)	(0.0072)	(0.0091)	(0.0091)	(0.0091)
State export share	-0.0873***	-0.0907***	-0.0596***	-0.1029***	-0.1029***	-0.1028***
	(0.0081)	(0.0069)	(0.0082)	(0.0081)	(0.0081)	(0.0081)
Herfindahl of intermediaries	0.1787***	0.1552***	0.1385***	0.2218***	0.2217***	0.2216***
	(0.0226)	(0.0163)	(0.0241)	(0.0212)	(0.0212)	(0.0212)
Herfindahl of direct exporters	-0.0494***	-0.0507***	-0.0339***	-0.0666***	-0.0666***	-0.0667***
	(0.0067)	(0.0065)	(0.0057)	(0.0068)	(0.0068)	(0.0068)
Ln Number of intermediaries	0.0672***	0.0678***	0.0480***	0.0815***	0.0814***	0.0813***
	(0.0038)	(0.0035)	(0.0040)	(0.0042)	(0.0042)	(0.0042)
Ln Number of direct exporters	-0.0412***	-0.0453***	-0.0261***	-0.0538***	-0.0539***	-0.0540***
	(0.0024)	(0.0027)	(0.0020)	(0.0031)	(0.0031)	(0.0030)
HS6–product fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
City fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	51,233	51,233	51,233	51,233	51,233	51,233
R2	0.3	0.3	0.3	0.35	0.35	0.35

Note. Heteroskedasticity-robust standard errors clustered at the city level appear in parentheses. SD, standard deviation. ***,**,* Denote significance at the 1%, 5%, and 10% confidence levels, respectively. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on the residual of a regression of the Herfindahl index on a quad- ratic in firm exports and firm ownership dummies (Equation 1) using the median in all columns, except in column (3) where the 60th percentile is used. The products in the Herfindahl calculations are defined at the HS6 level, except in columns (1) and (2) which use the HS4 and HS2 levels respectively.

Table A4 Specialized intermediaries and quality differentiation: Sample checks

Dependent variable	Share in city–HS6 exports of specialized intermediaries				
Sample restriction	No processing exports	No foreign exports	No Hong Kong destination	No group-related firms	No tobacco & cigarettes
	(1)	(2)	(3)	(4)	(5)
Quality dispersion	0.0008***	0.0005*	0.0005**	0.0005*	0.0007***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0002)
Foreign export share	-0.0631***		-0.0667***	-0.0649***	-0.0684***
	(0.0086)		(0.0094)	(0.0079)	(0.0091)
State export share	-0.0963***	-0.0938***	-0.1046***	-0.1077***	-0.1029***
	(0.0102)	(0.0093)	(0.0084)	(0.0107)	(0.0081)
Herfindahl of intermediaries	0.2106***	0.2522***	0.2172***	0.2145***	0.2217***
	(0.0123)	(0.0300)	(0.0203)	(0.0217)	(0.0212)
Herfindahl of direct exporters	-0.0663***	-0.0754***	-0.0648***	-0.0641***	-0.0666***
	(0.0059)	(0.0081)	(0.0062)	(0.0068)	(0.0068)
Ln Number of direct exporters	-0.0555***	-0.0609***	-0.0540***	-0.0530***	-0.0538***
	(0.0030)	(0.0031)	(0.0030)	(0.0031)	(0.0031)
Ln Number of intermediaries	0.0816***	0.0947***	0.0830***	0.0804***	0.0815***
	(0.0042)	(0.0055)	(0.0044)	(0.0044)	(0.0042)
HS6–product fixed effects	Yes	Yes	Yes	Yes	Yes
City fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	50,685	50,143	50,231	50,276	51,231
R^2	0.33	0.33	0.34	0.34	0.35

Note. Heteroskedasticity-robust standard errors clustered at the city level appear in parentheses. ***,**,* Denote significance at the 1%, 5%, and 10% confidence levels, respectively. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on the residual of a regression of the Herfindahl index on a quadratic in firm exports and firm ownership dummies (Equation 1), with products defined at the HS6 level.

Table A5 Intermediation and export quality: Robustness checks (1)

Dependent variable	Firm quality of exports (product-country) in 2005: ln Λ_{fpc}			
	Herfindahl cut-off			
	Median HS4	Median HS2	Conservative definition of intermediaries	No mono-product
	(1)	(2)	(3)	(4)
Specialized intermediary	0.232***	0.239***	0.056	0.067
	(0.064)	(0.059)	(0.070)	(0.071)
Generalized intermediary	-0.794***	-0.802***	-0.755***	-0.717***
	(0.045)	(0.046)	(0.043)	(0.043)
Ln Firm export value	-0.046	-0.079	-0.042	0.010
	(0.179)	(0.184)	(0.173)	(0.192)
Ln2 (Firm export value)	0.009	0.010*	0.009	0.008
	(0.006)	(0.006)	(0.006)	(0.006)
HS6–country fixed effects	Yes	Yes	Yes	Yes
City–HS6 product fixed effects	Yes	Yes	Yes	Yes
Observations	4,102,589	4,102,589	4,102,589	4,017,598
R2	0.23	0.23	0.23	0.23
F-test Bspec=Bgen	395	473.5	166.3	151.5
Proba>F	0.001	0.001	0.001	0.001

Note. Heteroskedasticity-robust standard errors clustered at the firm level appear in parentheses. ***,**,* Denote significance at the 1%, 5%, and 10% confidence levels, respectively. Three ownership-type dummies (state-owned enterprises, private firms, and foreign-invested firms) are included. Intermediary firms are defined following the procedure in Tang and Zhang (2012), except in column (3) where we use the conservative definition in Ahn et al. (2011). See the text. Specialized and generalized intermediaries are identified based on the residual of a regression of the Herfindahl index on a quadratic in firm exports and firm ownership dummies (Equation 1), with products defined at the HS6 level, except in columns (1) and (2) where the HS4 and HS2 levels are used. The F-test shown at the foot of each column tests the equality of the estimated coefficients on the two intermediary types. The probabilities (below 0.01) indicate that this equality is rejected at the 1% confidence level.

Table A6 Intermediation and export quality: Robustness checks (2)

Dependent variable	Firm quality of exports (product-country) in 2005: $\ln \Lambda_{fpc}$				
Sample restriction	No foreign firms (1)	No group related firms (2)	No restricted products (3)	No homogeneous products (4)	No tobacco & cigarettes (5)
Specialized intermediary	-0.032 (0.067)	0.052 (0.079)	0.031 (0.071)	0.045 (0.073)	0.031 (0.071)
Generalized intermediary	-0.774*** (0.043)	-0.821*** (0.047)	-0.778*** (0.044)	-0.780*** (0.045)	-0.778*** (0.044)
Ln Firm export value	-0.305** (0.152)	-0.076 (0.191)	-0.038 (0.175)	-0.031 (0.181)	-0.038 (0.175)
Ln2 (Firm export value)	0.015*** (0.102)	0.010 (0.007)	0.009 (0.106)	0.009 (0.110)	0.009 (0.106)
Firm ownership dummies	Yes	Yes	Yes	Yes	Yes
HS6 product–country fixed	Yes	Yes	Yes	Yes	Yes
City–HS6 product fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	3,555,104	3,769,867	4,097,714	3,906,788	4,102,309
R2	0.26	0.24	0.23	0.23	0.23
F-test bspec = bgen	166.6	175.1	184.5	179.7	184.8
Proba >F	0.001	0.001	0.001	0.001	0.001

Note. Heteroskedasticity-robust standard errors clustered at the firm level appear in parentheses. ***,**,* Denote significance at the 1%, 5%, and 10% confidence levels, respectively. Three ownership-type dummies (state-owned enterprises, private firms, and foreign-invested firms) are included. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on the residual of a regression of the Herfindahl index on a quadratic in firm exports and firm ownership dum- mies (Equation 1), with products defined at the HS6 level. The F-test shown at the foot of each column tests the equality of the estimated coefficients on the two intermediary types. The probabilities (below 0.01) indicate that this equality is rejected at the 1% confidence level.

Chapter 3

Export Orientation, Demand Uncertainty and Innovation Premium: Evidence from Chinese firms

I. Introduction

In this paper, I investigate the export-innovation nexus. Previous literature has focused on the causal link between firm heterogeneity and trade: some studies have explored the impact of productivity on trade behavior, whereas others have considered the reverse link from trade to productivity by investigating the various channels whereby innovation-led productivity growth is rewarded by trade liberalization. This paper, studies how firms' market choice of export orientation affects their innovation activity, and shows the role of demand uncertainty in the negative association between export orientation and innovation efforts. I provide robust empirical evidences, taking advantage of the exhaustive firm-level data on trade and R&D investment in China.

Figure 1 below motivates this analysis. As shown in Figure 1 (left-hand side), the curves depict the average R&D investment, R&D intensity, number of R&D investors and total factor productivity (TFP) for each percentile in exports' value share. I find a negative link between the export share and R&D investment, R&D intensity and number of R&D investors. As this finding could be challenged by the productivity distortion in China,[1] I investigate whether the reduction of R&D investment accompanies a decreasing tendency of productivity. I find that the log TFP level changes very slightly across the centile groups of export share, and the negative association between export share and R&D investment is not attributed to the worsening of productivity. Thus, the exporters are expected to be prone to either reducing or even abandoning their innovation efforts when they are primarily oriented towards international markets. I then attempt to empirically understand the innovation behavior of exporters in reaction to the export markets' conditions, focusing on the demand uncertainty effect as a fixed cost of exporters' innovation activity.

[1] The literature finds that there is a productivity distortion in China, namely the productivity of exporting firms is not higher than that of non-exporters, which lies particularly in the case of processing trade firms (Manova and Yu, 2016; Dai et al., 2016), which means that it is very likely that the firms export all the production is just because they are worse firms of low productivity and low R and D relative to domestic-oriented exporters.

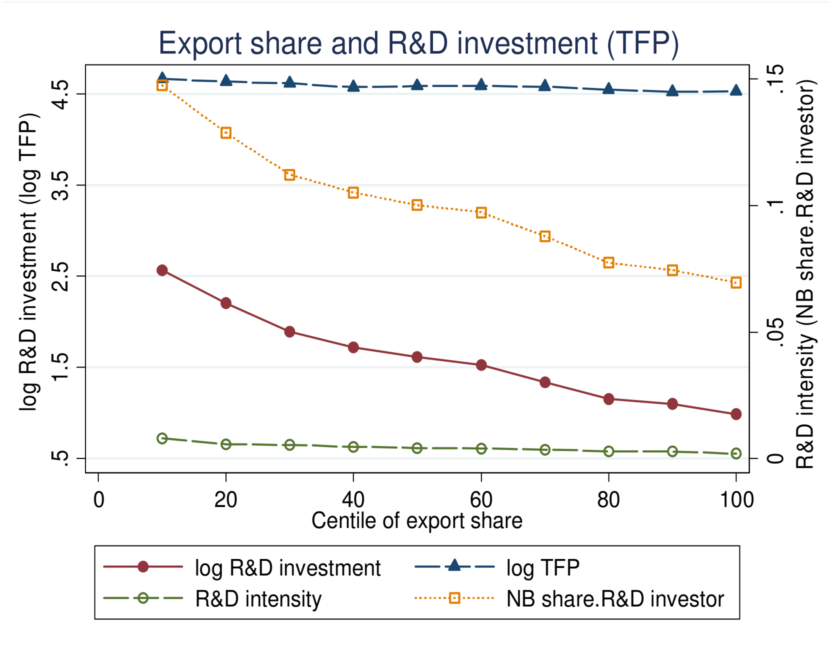

Figure 1 The relationship of export share and R&D investment

Notes: Centiles of export share are computed each year from 2004 to 2006 separately and then pooled together. For each centile, I compute the average R&D investment, R&D intensity, number of R&D investors over total exporters, and log TFP. All the firms are exporters, excluding firms whose export value share over sales is higher than 90% (process trade firms).

The debate on the argument of "exporting induced innovation" is still continuing.[2] The literature gives the supporting evidence, showing the empirically positive link between ex-ante exporting activity and the sequent promotion of innovation and productivity [e.g., De Loecker (2007, 2013), Mallick and Yang (2013) and Biesebroeck (2005)]. These findings indicate that the participation in exporting stimulates firms to increase their innovation efforts and, consequently, achieves a greater productivity premium of exporter relative non-exporter. However, the relationship between export and innovation could be negative when the export size is considered. Some literature finds that exporters reduce or even drop the investment on R&D along with the growth of export intensity, the reasons of which are proposed from the view such as the presence of processing trade firms [e.g.,Manova and Yu (2016) and Dai et al.(2016)] and the competition effect in the international market [e.g., Aghion et al.(2018)]. The former shows the processing trade firms in China as outlines who just manufacture following the requirement of outsourcers instead of innovating by themselves. The latter documents a

[2] The earlier literature considers that exporting correlating with better performance is just due to the selection effect. Clerides et al. (1998) found the productivity effect of exporting was attributed to the self-selection effect rather than the learning effect, and exporting itself could not help firms improve their productivity in a significant manner. For similar findings, see Bernard and Jensen (1999). But the recent studies, such as De Loecker (2007,2013), Mallick and Yang (2013) and Biesebroeck (2005), give a lot evidence on learning effect of exporting in the samples of Slovenian, Chinese, Indian and sub-Saharan African respectively.

serious competition effect in the international markets that dissipates the markups and innovation investment of exports especially for firms of low productivity. In addition to consideration of the competition effect on firms' innovation behavior, the impact of the uncertainty effect has also been a subject of sharp focus in the literature (Arrow, 1968; Bernanke, 1983; Mc Donald and Siegel, 1986; Bertola, 1988; Pindyck, 1988; Dixit and Pindyck, 1994; Guiso and Parigi, 1999; Bloom, 2007; Bloom et al., 2007). Studies document that uncertainty plays a negative role in R&D investment when the irreversibility of R&D investment is emphasized. An irreversible investment entails an opportunity cost that precludes the option of investing in the future when more is unknown (Guiso and Parigi, 1999). Thus, the increase in uncertainty causes a abandon and a rebound in R&D investment, or even makes firms less responsive to the innovation incentives (Bloom, 2007; Bloom et al., 2007). In the context of international trade, uncertainty is emphasized in the analysis of export performance. A high frequency of entry and exit of new exporters in the international market can be explained as a response of an exporter to the uncertainty of a new market, that is, "trial-and-error" behavior (Nguyen, 2017). Moreover, Jose De Sousa et al. (2018) not only find the similar result of the demand uncertainty effect on firm survival in the international market, but also confirm the negative link between the uncertainty and trade value of extensive and intensive margin, and the export price. However, the impact of uncertainty on the innovation activities of exporters are less considered so far. As the irreversibility R&D investment, the "trial-and-error" approach is not adopted in the decision-making of innovation, since it is too costly for most exporters to afford. Therefore, the answers to several questions remain unclear: How do exporters change their innovation behavior to react to the risk in the destination markets? Does demand uncertainty play a significant role in the reduction, postponement, or even abandoning of exporters' innovation efforts? Is innovation behavior under uncertainty heterogeneous for the exporters with different levels of productivity?

In this paper, I use Chinese firm-level panel data to empirically analyze how market orientation choice (export or domestic market orientation) impacts exporters' R&D investment and provide evidence about demand uncertainty in the domestic market as a fixed cost to decrease exporters' engagement in innovation. Replying on two exhaustive Chinese firm-level datasets -- China Annual Survey of Industrial Firms (ASIF) and Chinese Customs Trade Statistics (CCTS), I empirically analyze the link between the market orientation choice (export or domestic market orientation) and the R and D investment by exporting firms, giving the evidence on the demand uncertainty in the international market as a fixed cost to impact the exporters' innovation decision, and show the productivity as a requirement that allows firms to participate in innovation activity under the environment of international uncertainty. I find that (1) the shift from the domestic orientation to the export orientation within one firm is accompanied by a subsequent reduction of R and D investment and R and D participation probability; (2) the change of firms' innovation efforts accompanied by the transformation of market orientation is particularly pronounced in the case of their export activities subject to the demand uncertainty in the international markets; (3) this finding seems to be reinforced when firms enter new markets, while be attenuated in the case of firms with richer international experience; and (4) the innovation behaviors of heterogeneous firms reacting to the demand uncertainty are different: R and D investment increases even if under the condition of high uncertainty for initially more productive firms, while the effect is reversed for less productive firms as the negative uncertainty effect dominates. The results above indicate that the uncertainty of demand imposes a fixed cost that discourages the innovation efforts by exporting firms, while high productivity and full experience allows firms to participate in innovation by overcoming the uncertainty in the international activity.

Aghion et al. (2018) is closest literature to this chapter, which looks at the phenomenon of exporters' reduction of innovation efforts under the positive export shock from the perspective of the demand side. Following this idea, I examine the link between the market choice of export orientation and R&D investment of firms. I differ from them by three sides. (1) The existing literature looks at the impact of export behavior (whether export or not) or export size on the performance of firms. Instead, this chapter focuses on the impact of export intensity, examining how the market orientation choice (export- or domestic-orientation) affects the firms' innovation behavior under the condition that the market size of sales is controlled for. The Chinese firm-level data reveals a bimodal distribution of export share, which allows us to measure the characteristics of export intensity of firms by a discrete variable of export-oriented dummy rather than a continuous variable of export share. By comparing the R&D investment and R&D intensity between export-oriented and domestic-oriented exporters, I uncover a rather intuitionally negative association between export orientation and R&D investment as well as R&D intensity of firms. Furthermore, the statistics of two types of firms indicate that the negative link above is not triggered by the selection problems that domestic-oriented firms are inherently better than export-oriented firms, and the negative link still stands even if the processing trade firms are excluded. Based on the empirical study, I find that firms reduce their innovation efforts when switching from being domestic-oriented to being export-oriented, while the change of firms from the status of non-exporters to exporters is accompanied by increased R&D investment. (2) The negative link between the market size and innovations of exporters is attributed to the competition effect in the international market (Aghion et al., 2018). Instead, this chapter explores an additional explanation of demand uncertainty effect. In terms of the negative coefficient on the interaction term of export orientation and demand uncertainty, I find that the reduction in R&D investment is particularly pronounced in the case of export activities subject to demand uncertainty. The demand uncertainty is measured from three sides: preferential uncertainty, the volatility of demand size and capability and the country risks. Firstly, measuring the preferential uncertainty by employing the culture gap between destination countries and China (e.g., language, history, geographic location, gen) to describe the preferential uncertainty of foreign customers. As indicated in the literature, the cultural diversity between the bilateral trade partners is used to measure the demand uncertainty in the foreign markets faced by exporters (Morales et al., 2014; Fernandes and Tang, 2014). The cultural differentiation makes exporters difficult to predict the preference of customers abroad in terms of their own favors, habit, and belief that includes in the cultural background, which consequently brings about the demand uncertainty faced by exporters. Secondly, measuring the volatility of demand size based on the dispersion of GDP and GDP per capita in the destination country. Thirdly, calculating the country-level risks based on the economic and financial risk index released by ICRG. The higher level of economic and financial risks in the destination countries implies that the prospect of economy could be not optimistic or even worse, so that consumers could change their consumption behavior such as declining the expenditure of high-priced products, or cutting off the current spending so as to prevent the risks induced by the economic uncertainty. Therefore, a greater level of the economic and financial risks in the destination countries raises the uncertainty of demand size faced by exporters. (3) This chapter expands the analysis on the nexus of export orientation and R&D premium by investigating the role of trade experience and high productivity on overcoming the demand uncertainty in the international market. The literature documents that exporting experience helps to relieve the demand shock by exporters' accumulation of demand information in the foreign markets (Sheard, 2014; Carrère, 2014; Fernandes and Tang, 2014). Follow the idea of Kudamatsu (2012) and Alder (2013), I reproduce the benchmark regression, but decompose the export-oriented dummy into two types of NEW and OLD in terms of the exporting experience of exporters. The results show that the coefficient on the interaction term of old (export-oriented firm) and demand uncertainty is insignificant, while that of new (export-oriented firm) stands negative significantly. This indicates that experience helps to moderate the uncertainty effect on the link of "export-innovation". Meanwhile, I look at how the firms of heterogeneous productivity change the innovation behavior as the response to the demand uncertainty. I regress the log

R&D investment on the triple interaction term of export orientation dummy, the proxy of demand uncertainty and the dummy of firms of high productivity. The coefficients on the triple interaction terms show that the impacts of demand uncertainty on the R&D investment turn to be positive at the firm-level productivity around the seventh decile, implying that high productivity allows firms to participate in innovation activities by overcoming the fixed cost induced by uncertainty.

The potential endogenous problem is moderated by (1) ruling out the processing trade exporters, so as to avoid that the finding from high export participation to low innovation efforts could be reverse going from low productivity or low R&D to picking up an export orientation mode; (2) employing the IV approach to check the potential estimation bias attributed to the reversed causality from innovation performance to export participation; (3) using a dependent variable of one year forward to reduce the potential reversed causality, (4) controlling the firm-level productivity and scale to moderate the potential selection problem of export-oriented firms; and (5) including the fixed effects in the regression function to reduce the problem of omitted variables, such as timing invariant factors of firms and timing variant factors in the city and sector pairs.

This paper complements a recent body of the literature on learning by exporting are from three sides: firstly, the literature documents a positive effect of exporting participation in promoting innovation and the subsequent increase of productivity of exporters (De Loecker, 2007; De Loecker, 2013; Mallick and Yang, 2013), giving evidences on the innovation premium by participating in export. However, less attention is taken to the impact of export scale and intensity on the innovation efforts by exporters. The closest literature to this chapter is the Aghion et al. (2018), which focuses on the nexus of export size and innovation behavior by exporters. They explain that due to the competition effect, the increase of international market size is associated with the underperformance of innovation efforts by most exporters. Instead, this chapter provides an additional explanation, confirming the demand uncertainty from the market volatility, information asymmetry of demand preference and other kinds of risks in the destination countries as a fixed cost that discourages the innovation efforts by exporters. Therefore, the findings are serviced as the compensation of the literature, to explain the negative association between the export activity and innovation by exporters. Secondly, the results in this chapter expand the analysis of uncertainty effect by exploring their influence from export performance to the innovation efforts. Instead of the studies on the link of uncertainty and export behavior and performance (Nguyen, 2017; Jose De Sousa et al., 2018), this chapter looks at how the uncertainty changes the innovation behavior of exporters. This result indicates that the uncertainty of demand imposes a fixed cost that discourages innovation efforts by exporting firms, the idea of which is indirectly confirmed by the experience effect and productivity effect that help to moderate the negative link of export orientation and innovation by overcoming the trade cost from uncertainty. Hence, all the findings above also rich the analysis of trade cost by confirming the effect of uncertainty as a kind of fixed cost on exporters' innovation behavior. Thirdly, this chapter provides a new perspective, explaining why deeper participation in exporting is not accompanied by an increase of innovation investment. The underperformance of innovation conducted by export-oriented firms is attributed to the presence of processing trade firms in the literature such as Manova and Yu (2016) and Dai et al. (2016). Instead, the this chapter shows the negative effect of demand uncertainty on the reduction of R&D efforts, the result of which also helps to understand why policies of innovation incentive are helpless to improve the firms' innovation under the international condition of high uncertainty.

The paper proceeds as follows. Section 2 provides the stylized facts of export orientation and R&D investment of Chinese firms. Section 3 presents the empirical results of benchmarks and a set of robustness checks. Section 4 investigates the role of demand uncertainty in the international markets. Section 5 further explores the innovation behavior of heterogeneous firms under the uncertainty environment. The final section concludes.

II. Export Orientation and R&D Investment in China

A. Data

Two proprietary datasets are employed on the analysis of the innovation activities of Chinese exporters, combining "Annual Survey of Industrial Firms" (ASIF) China's National Bureau of Statistics with the Chinese Customs Trade Statistics (CCTS) collected by the Chinese Customs Office.[3]

ASIF provides companies with sales standard balance-sheet data for manufacturing firms with sales over 5 million Chinese Yuan. I observe each firms' location in one of 321 cities and its main industry of activity out of 399 finely disaggregated categories in the Chinese GBT 4-digit classification. The main variables of interest to us are measures of firm-level sales orientation status and R&D investment, which is discussed in detail below. I also use information on total employment, capital and material inputs to measure proxies of firm size and productivity. CCTS reports the value of firm exports (free on board) and imports (cost,

[3] The way of combination follows Manova and Yu (2016).

insurance, and freight included) in U.S. dollars. The records indicate whether each cross-border sale occurs under ordinary trade, processing and another type of regime. This allows us to identify the processing trade firms in terms of the export value share under the processing trade. The combined data of ASIF and CCTS is also employed by Manova and Yu (2016), and CCTS has been used in the literature such as Ahn et al. (2010), Fernandes and Tang (2014) and Poncet and Xu (2018).

The empirical analysis relies on the panel data from 2004 to 2006 based on the combining data of ASIF and CCTS in the benchmark regression.[4] As the exporters who switch the market orientation between export and domestic type account for about only 15% over the total sample, the cross-sectional data in 2006 is also employed as the robustness check. The summary of variables is reported in Table A1 in the appendix.

It's important to note that I exclude the processing trade firms in all the empirical analysis in this paper, so as to relieve the potentially reversed causality attributing to them. The processing trade firms are defined as whose export value share over total sales is higher than 90%, following Manova and Yu (2016), and the firms whose export value share under the process trade regime over total export value is higher than 50% are additionally removed as the robustness check.

B. Statistics of export orientation in China

There are two kinds of exporters in China in terms of market orientation. As shown in Figure 2 (left), there is a bimodal distribution of firm-level export share (export value over sales) in the total sample. Moreover, as shown in Figure 2 (right), this finding keeps constant when the processing trade firms are excluded, or ordinary trade firms are remained solely, implying that the bimodal distribution of export share is not driven by the presence of processing trade firms. The distribution of two-peak shape suggests that there are two separate groups of exporters standing out: to the right is characterized by higher export intensity, while to the left uncovers higher sales intensity in the domestic market. I refer to the former as export-oriented exporters (EXPO) and the latter as domestic-oriented one (DOMO). In the benchmark regression of this paper, the export-oriented exporters (EXPO) are defined as whose export value is dominated in its total sales value, namely export share more than 50% over the total sales. The domestic-oriented exporters (DOMO) are defined as reverse. I also replace the cutoff of export share by the median, 60%, 70% and 80% as the robustness checks.

[4] As the R&D investment data of Chinese firms is only reported in the years of 2005,2006 and 2007 in ASIF, we are allowed to have a panel data from 2004 to 2006, with the dependent variable of R and D investment of one year forward.

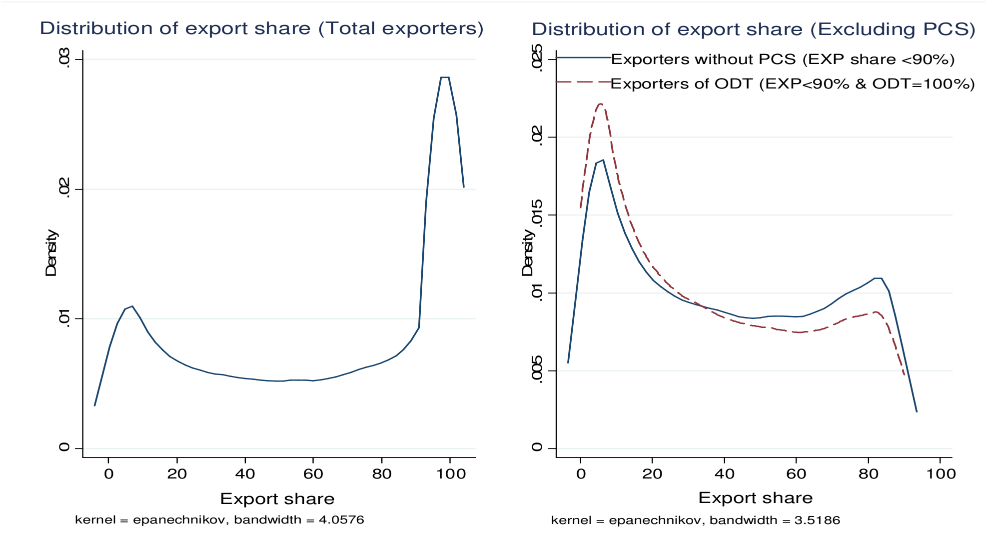

Figure 2 Distribution of firm-level export value share

Note: The left-hand panel shows the distribution of the export value share in the total sample of combined ASIF and CCTS database in 2006. In the right-hand panel, the curves of export value share distribution are made in the samples without processing trade firms and the sample of ordinary trade firm, respectively. The processing trade firms are defined whose export value share over the total export value is higher than 90%. The ordinary trade firms are additionally defined who conduct exporting under the ordinary trade regime solely.

Table 1 reports the number share of export-oriented exporters in terms of the different cut-offs of export value share from the year 2004 to 2006. The statistics in the total sample and subsample without processing trade firms are reported in panel A and B, respectively. In the sample without processing trade firm, the export-oriented exporters account for about 40% over the total exporters when the export share of 50% is regarded as a cut-off. When the cut-off is replaced by the 60%, 70% and 80% of export value share respectively, the number proportion of export-oriented exporters to domestic-oriented exporters is about 3:7, 2:8 and 1:9. The number pattern of export-oriented and domestic-oriented exporters changes slightly over time.

Table 1 Number share of export-oriented exporters

	Number share of export-oriented exporter over total exporters			
	different cut-offs of export share :			
	>50%	>60%	>70%	>80%
Panel A Total exporters				
2004	56.16	51.76	47.24	41.90
2005	63.72	58.72	53.59	47.53
2006	62.13	56.89	51.52	45.28
Panel B Excluding processing trade firms				
2004	36.58	29.00	20.90	11.95
2005	39.60	31.28	22.74	12.66
2006	38.79	30.32	21.64	11.56

Note. In table 1, the processing trade firms are defined whose export value share over the total sales value is higher than 90%. I report the number proportion of export-oriented firms over the total exporters in the year 2004, 2005 and 2006, which is measured based on the combining data of ASIF and CCTS.

Table 2 lists the statistics on the mean and weighted mean of log R&D investment and R&D intensity by exporter type, the latter is calculated with the employee number as weights. Panel A, B, and C report the results in the sample of total firms, total exporters and the subsample without processing trade firms, respectively. The statistics reported in column (1) and (2) shows that, R&D investment conducted by the domestic-oriented exporters are more than that of export-oriented firms, with the weighted average of 5.02 of DOMO and 0.59 of EXPO in panel A, 4.54 of DOMO and 1.36 of EXPO in panel B, as well as 4.79 of DOMO and 1.95 of EXPO in panel C. As shown in column (3) and (4), it is similar in the comparison of R&D intensity between two types of exporters.

The R&D investment handled by exporter is more than that of non-exporters in Panel A, implying that the sorting of log R&D investment by exporter type is similar to that of productivity, namely, exporter is superior to non-exporter. Nevertheless, the statistics of the R&D intensity shows a distortion between export-oriented exporters and non-exporters, which could be due to the presence of processing trade firms in the sample. As shown in Panel C, the weighted mean value of the R&D intensity of export-oriented firms increase to 0.47 when the processing trade firms are excluded, which is higher than that of non-exporters (0.41). Thus, in the R&D investment-sorting setting, export is better than non-exporter, but domestic-oriented exporter is superior to export-oriented exporters.

Table 2 Summary statistics on R&D investment by firm type

	Firm-level log R&D investment (thousand yuan)		R&D intensity (%)	
Firm type	Mean	Weighted mean	Mean	Weighted mean
	(1)	(2)	(3)	(4)
Panel A: Total firms				
Export-oriented exporter	0.51	0.59	0.12	0.13
Domestic-oriented exporter	1.36	5.02	0.39	0.80
Non-exporter	0.42	1.48	0.38	0.41
Panel B: Exporters				
Export-oriented exporter	0.61	1.36	0.14	0.22
Domestic-oriented exporter	1.65	4.54	0.50	0.79
Panel C: Exporters excluding processing trade firms				
Export-oriented exporter	0.91	1.95	0.24	0.47
Domestic-oriented exporter	1.72	4.79	0.52	0.84

Note. The results in Table 2 are based on the sample of combined ASIF and CCTS database in 2006. The export-oriented exporters are defined as those with the export share higher than 50% and the domestic-oriented exporters are reversed. R&D intensity is the export value over total sales of each firm. The processing trade firms are defined whose export value share over the total sales is higher than 90%. The employee number of each firm is employed as weights.

Figure 3 (left hand) compares the log R&D investment between exporter types namely, export-oriented (EXPO) and domestic-oriented exporters (DOMO). The processing trade firms are removed when the distribution curve of log R&D investment is made. Export-oriented exporters are shown of lower R&D investment than domestic market oriented exporters. Additionally, Figure 3 (right hand) shows the average R&D investment of export-oriented exporters defined by different cut-offs of the median, the 60th percentile, the 70th percentile and the 80th percentile of export share, respectively. With the cut-off of export share replaced by the higher percentile, the distribution curve of average R&D investment of export-oriented firms moves from the right to the left side. This robustly indicates that when firms are more export-intensive, they are less motivated to invest on R&D.

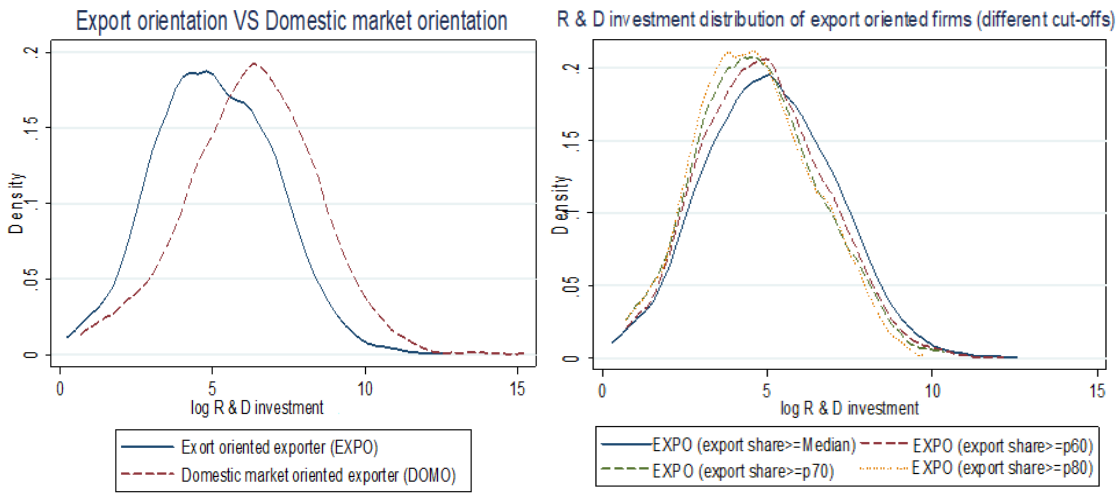

Figure 3 Distribution of firm-level R&D investment

Note. The results in Figure 3 are based on the sample of combined ASIF and CCTS database in 2006. In Figure 2 (left hand), the distribution of R&D investment by market orientation is reported for the comparison of the difference of R&D investment between export-oriented and domestic-oriented exporters. The export-oriented exporters are defined as those with the export share (share of export value over sales) higher than 50% and the domestic-oriented exporters are reversed. The processing trade firms are defined whose export value share over the total sales is higher than 90%. In Figure 3 (right hand), I compare the R&D investment of export-oriented firms when they are defined in terms of higher percentiles as cut-offs. The export-oriented firms are defined as those with the export share higher than the median, 60th, 70th and 80th percentiles of export share respectively.

Furthermore, the statistic on R&D investment of exporters who change the market orientation in the period of the sample is reported. The literature documents that when firms enter the new market, they could increase the innovation-related investment for technology improvement or product development so as to capture the market share with the pre-existing competitors in the market. Therefore, it should be expected that the switch of market orientation, no matter from export to domestic orientation or reverse, should be correlated with the increase in R&D investment. As shown in Figure 4 (right side), the curve of firm's R&D investment distribution moves from left to the right side from the year 2004 to 2006. This indicates that the shift from the international market to domestic ones is associated with an increase in R&D investment. However, as shown in Figure 4 (left side), when firms change from domestic- to export-orientated type, they are inclined to reduce the R&D investment in the subsequent years, which is reflected by the movement of R&D investment distribution curve from the year 2004 to 2006. The features of the reduction on R&D investment by firms who switch towards international markets is consistent with the findings above, robustly showing the lower level of R&D investment by firms being oriented to the exporting market.

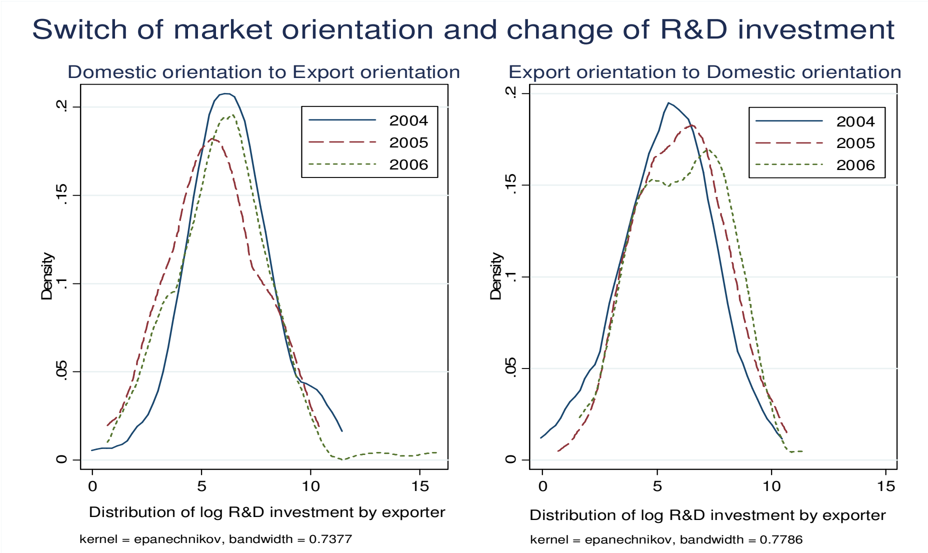

Figure 4 Firm-level R&D investment distribution by the types of market orientation switch

Note. The results in Figure 4 are based on the sample of combined ASIF and CCTS database from 2004 to 2006. The export-oriented firms and domestic-oriented firms are separated from the export share of 50% as a cut-off. The processing trade firms are defined whose export value share over the total sales is higher than 90%, and are excluded in the sample. In the left side of Figure 4, the log R&D investment distribution of exporters who switch from domestic orientation to the export orientation is reported, while in the right side, I show the R&D investment distribution of exporters whose market orientation is changed from export to domestic type from 2004 to 2006.

Additionally, I investigate whether the difference in R&D investment between export-oriented and domestic-oriented exporters are due to the inherent heterogeneity in terms of the firm size, productivity, and financial health. Table 3 lists the firm-level summary statistics of the mean and weighted mean of firm-level characteristics, the latter of which is computed with the number of the employee as weights. As a small number of exceptionally large firms may dominate trade, the differentiation between export and domestic-oriented exporters is based on the weighted mean. Two types of exporter differ in export value, export share R&D investment and R&D intensity, while approximate in export value share of processing trade (lower than 6%) and ordinary trade (higher than 94%), total factor productivity level (about 4.5) and financial constraints.

As seen in row 1, export-oriented firms export much more than domestic-oriented exporters, with the weighted mean value of RMB 54,142 thousand and RMB 39,927 thousand. The result in row2 shows a larger share of export value of export-oriented firms than domestic-oriented ones, with the weighted mean share of 87.03% and 18.63%, respectively. However, as seen in row 3, the R&D investment of export-oriented exporters is much lower than that of domestic-oriented exporters, with the weighted mean value of RMB 189 thousand and RMB

3,312 thousand, respectively. Therefore, the statistic results clearly show a link between high export orientation and low R&D investment. On the contrary, two types of exporters are similar in terms of trade regime pattern, TFP level and financial constraints. As shown in row 5 and 6, export-oriented exporters are close to the domestic-oriented exporters, with the weighted mean ordinary trade share of more than 94%. As shown in row 7, there is no large difference on TFP level between them, with the weighted mean of 4.60 of export-oriented exporters and 4.66 of domestic-oriented ones. Meanwhile, we employ two proxies for the sector-level financial vulnerability and firm-level financial healthy, namely inventories to sales ($Invent_s$), asset tangibility (*Tangi*), current liabilities to current assets ($Leverage\ ratio_i$) and the difference between current assets and current liabilities ($Liquidity_i$), respectively.[5] The results listed in row 8 to 11 are approximated between two types of exporters.

Hence, the gap of R&D investment and R&D intensity between export-oriented and domestic-oriented exporters is attributed to some factor else, but not the heterogeneous scale, productivity and financial constraints of firms.

Table 3 Firm-level statistics of export and domestic-oriented exporters

	Export-oriented exporter		Domestic-oriented exporter	
	Mean	Weighted Mean	Mean	Weighted Mean
Export value (thousand yuan)	46,940	54,142	29,123	39,927
Export share	87.06	87.03	18.96	18.63
R&D investment (thousand yuan)	147	189	2,101	3,312
R&D intensity (%)	0.24	0.47	0.52	0.84
Export value share of PCS	5.02	5.29	2.63	2.75
Export value share of ODT	94.78	94.52	97.13	96.93
Productivity (log TFP)	4.58	4.60	4.63	4.66
$Invent_s$	0.17	0.17	0.18	0.18
$Tang_s$	0.25	0.25	0.27	0.27
Leverage ratio	0.58	0.58	0.59	0.59
Liquidity	0.14	0.13	0.16	0.17

Note. The statistics reported in Table 3 is based on the sample of combined ASIF and CCTS database in 2006, without the processing trade firms who are defined whose export value share over total sales is higher than 90%. The export-oriented exporters are defined as those with export intensity (share of export value over sales) higher than 50% and the domestic-oriented exporters are reversed. R&D intensity is the export value over total sales of

[5] As indicated in Manova and Yu (2016), the ratio of inventories to sales (*Inventi*) is used to proxy the duration of the manufacturing process and the working capital firms require, in order to maintain the inventories and meet demand. This measure indexes producers' liquidity needs in the short run, which are associated mainly with variable costs such as the cost of labor and intermediate inputs. The asset tangibility (*Tangi*) is defined as the share of net plant, property and equipment in total book-value assets, reflecting the firms' ability to raise external finance. *Liquidity* gives the difference between current assets and current liabilities, scaled by total assets. It signals firms' availability of liquid capital. Leverage is the ratio of current liabilities to current assets.

each firm. Productivity (log TFP) is the log of total factor productivity. The variable of export value share of PCS (ODT) is the processing trade (ordinary trade)

C. Export-innovation nexus under the demand uncertainty

The firm-level proxies of demand uncertainty in the international market are measured as follows. By defining the two groups of countries (high insecurity or not), I compute a product level export value share exporting to the high uncertainty destinations, presuming that a product is prone to high demand uncertainty when its export is dominated by "risky" countries. Then, I estimate the firm-level demand uncertainty with the firm's initial export share of the product (HS6) as weights. Assigning the uncertainty to the profile of the foreign demand, the formula is as follows:

$$DU_{ft} = \sum_{p} \frac{EXP_{fpt_0}}{EXP_{ft_0}} \left(\frac{\sum_{c} EXP_{pct} * Dummy\ Uncertainty_c}{EXP_{pt}} \right) \tag{1}$$

where f denotes firm, t denotes a year, t_0 denotes the first year of the sample, c denotes the destination country, p denotes the product of HS6-digits. EXP_{pct} and EXP_{pt} denote the (p,c) and (p) export value at time t all over the world, respectively. $Dummy\ Uncertainty_c$ equals to one when the uncertainty level of destination country c is higher than the median of the total. The weight (EXP_{fpt0}/ EXP_{fto}) represents the firm f's initial export share in HS6 over the firm's the total exports at the time t_o, so that the timing variation of demand uncertainty DU_{ft} stem from the export share of products to the risk country but not the product choice of firm.

The demand uncertainty is measured from three sides: preferential uncertainty, the volatility of demand size and capability and the country risks. Firstly, measure the preferential uncertainty by employing the culture gap between destination countries and China (e.g., language, history, geographic location, gen) to describe the preferential uncertainty of foreign customers.[6] As indicated in the literature, the cultural diversity between the bilateral trade partners is used to measure the demand uncertainty in the foreign markets faced by exporters (Morales et al., 2014; Fernandes and Tang, 2014). The cultural differentiation makes exporters difficult to predict the preference of customers abroad in terms of their own favors, habit, and belief that includes in the cultural background, which consequently brings about the demand uncertainty faced by exporters.

Secondly, measure the volatility of demand size, relying on the dispersion of GDP and GDP

[6] The data of common language, same country in history is available from CEPII, genetic distance is from Enrico Spolaore and Romain Wacziarg (2016).

per capita in the destination country. GDP is regarded as the proxy of demand size, while GDP per capita is usually considered the proxy of income level. Thus, they are employed to weigh up the variation of market size and consumption capability in the destination countries. The dispersion is measured based on the standard deviation in the first ten years before the first year of the sample, the inter-decile from the 25th percentile to the 75^{th} percentile and the gap of maximum and minimum of GDP and GDP per capita are computed as robustness checks.

Thirdly, the demand uncertainty proxy is calculated based on the country-level economic and financial risk index released by ICRG.[7] The higher level of economic and financial risks in the destination countries implies that the prospect of economy could be not optimistic or even worse, so that consumers could change their consumption behavior such as declining the expenditure of high-priced products, or cutting off the current spending so as to prevent the risks induced by the economic uncertainty. Therefore, a greater level of the economic and financial risks in the destination countries raises the uncertainty of demand size faced by exporters.

Based on the measurement approach mentioned above, a set of statistic results are presented for the comparison of the weighted mean R&D investment and R&D intensity of exporters in the sector of high and low demand uncertainty, respectively. The statistics report in Table 4 is measured based on the product-level proxies of DU. The median value of DU is used as a cut-off to separate the high and low uncertainty group. The weighted mean of R&D investment and intensity is computed in the group of high and low uncertainty respectively, with the weights of employee number of firms. As shown in Table 4, the results indicate that the increase in the demand uncertainty in the destination countries is along with the decrease of log R&D investment and R&D intensity. The weighted mean of log R&D investment conducted by firms exporting to the destination countries of low uncertainty, is much higher than those exporting to the places of high uncertainty. It is the same as R&D intensity. Moreover, the finding keeps consistent no matter which proxy of DU is employed.

[7] The website of ICRG is http://www.prsgroup.com/.

Table 4 The statistics of R&D investment by demand uncertainty level

Proxies of demand uncertainty:		Log R&D investment (thousand yuan)		R&D intensity (%)	
		Low uncertainty	High uncertainty	Low uncertainty	High uncertainty
Cultural diversity	Common language	2.98	0.52	2.41	0.39
	History of same country	2.82	0.48	2.60	0.44
	Geographic location of common continent	2.73	0.56	2.51	0.47
	Genetic proximity	3.23	0.51	2.18	0.41
Economic tendency	Economic risks	3.43	0.59	1.81	0.30
	Financial risks	3.08	0.54	2.27	0.36
Income dispersion (Disp. PGDP)	S.D.	3.31	0.55	1.78	0.31
	Inter-decile	3.41	0.56	1.75	0.31
	Max-Min	3.67	0.64	1.52	0.24

Note. The statistics reported in Table 4 is based on the sample of combined ASIF and CCTS database in 2006, without the processing trade firms who are defined whose export value share over total sales is higher than 90%. High uncertainty is characterized by non-common language, history, geographic location of continent between destination countries and China, and the high risk of economy and finance, as well as the high dispersion of GDP and PGDP in the destination countries. Common language means that Chinese is one of the official languages in the destination countries. The meaning of the same country is that China and trade partners were the same country historically. Geographic location of common continent means the destination country is located on the same continent with China. The data of genetic proximity is from Spolaore and Wacziarg (2017). The economic and financial risk index is the tendency of countries' economic and finance development, which is from ICRG. The dispersion of PGDP is the standard deviation, inter-decile and gap between max and min of GDP per capita of all the destinations of each firm. The measurement of the proxies is reported in detail in the paper.

III. Empirical Analysis

A. Empirical specification

This section presents the empirical examination of the relation between the switch from ex-ante from domestic to the export orientation and subsequent R&D investment of exporters, employing the Chinese firm-level panel data from 2004 to 2006. I estimate the following specification:

$$log(R\ \&\ D)_{ft+1} = \alpha + \beta \times Dummy\left(Export\ \ Oriented\right)_{ft} + \delta \times Z_{ft} + \chi'_{\gamma} + \varepsilon_{ft} \qquad (2)$$

Where the subscript *f* said firm and subscript t said the year. The variable of *Dummy (Export Oriented)$_{ft}$* is the key variable that the regressor is interested in. It equals to one if the market choice of *f* is export orientation in *t* year, and equals to zero if the firm *f* has a status of domestic orientation in t year. I describe the export orientation by the discrete variable of export-oriented dummy instead of the continuous variable of export share, on the consideration of a bimodal distribution of export share in China. log(R&D)is the logarithm of R&D investment of firm *f* of one year forward, proposing the dependent variable of *log(R&D)$_{ft}$* for one year forward is to reduce the potential problem of reverse causality. The dummy of R&D investor (R&D>0) is used as an alternative proxy in the robustness check. Z is the vector of firm-level controls. I include the firm-level characteristics of the logarithm of total factor productivity (log TFP) and employment scale, so as to decrease the potential problem of selection induced by the intrinsic difference between two types of exporters.

X represents a vector of fixed effects ({FE}) discussed below. In all the regressions, the firm fixed effects are included to ensure that the exploration of the time-variant variation of market choice and subsequent R&D investment is within one firm. Additionally, as the city-sector (GBT 4)-year is too narrow for us to obtain enough observation, I turn to the wider pairs, adding the city-sector (GBT 1 digit)-year, and the province-sector (GBT 4 digit)-year fixed effects, so as to exclude both the time-variant and time-invariant characteristics in the specific location and sector dimensions. The standard errors in all of the regressions are clustered at the firm level to account for the correlation in the error terms within a firm.

The linear probability model is also used in the following specification so as to examine the influence on firms' decision of investing on R&D or not.

$$Pr[D(R\,\&\,D>0)_{ft}] = \alpha + \beta \times Dummy\left(Export\ Oriented\right)_{ft} + \delta \times Z_{ft} + \chi'_{\gamma} + \varepsilon_{ft} \qquad (3)$$

where D(R&D>0)$_{ft}$ equals to one when the R&D investment handled by one firm is higher than zero. I estimate Eq. (4) using a linear probability model, similar to Bernard and Jensen (2004) and Albornoz et al. (2012).[8]

B. Baseline results

The baseline results are reported in Table 5. In column (1), the correlation between the switch of the ex-ante status of non-exporter to the exporter and the subsequent log R&D investment (one year forward) in the total sample is explored, when adding the city-year pair, sector-year pair and firm fixed effects and controlling the firm level scale and productivity (TFP). The positive coefficient on the dummy of exporter reveals that the ex-ante status of exporter induces a higher degree of log R&D investment subsequently than non-exporters do, which shows the

[8] The benefit is that we can control for firm-year fixed effects, which cannot be done with a probit model. The well-known critique is that the relation explored can be nonlinear. However, it has been shown extensively (see, for example,Wooldridge, 2002 and Angrist and Pischke, 2009) that the average marginal effects from the probit estimates are usually very close to the linear estimates.

consistency of the findings in the literature.[9]

I then do the regressions in the sample of exporters solely following estimation (1), exploring how the switch of ex-ante choice from domestic to the export orientation affects the subsequent R&D investment of firms. The result in column (2) is based on the sample of total exporters, while the rest are without processing trade firms. In column (2), the coefficients on the regressor of interest--Dummy of the export-oriented firm is negative and statistically significant at the 5% level. As the negative association from export orientation to the innovation performance are challenged by the presence of processing trade firms (Manova and Yu, 2016; Dai et al., 2016), I exclude the processing trade firms of export value share higher than 90%, following Manova and Yu (2016). The result shown in column (3) is still negative with a significant sign, implying that the reduction of R&D investment induced by the transformation from domestic to export orientation, is not driven by the presence of processing trade firms. Furthermore, in column (4), when more unobserved time-varying factors in the city-GBT1 pair and sector (GBT4)-province pair are controlled for, the coefficient on the dummy of export-oriented firm keeps significantly negative. Meanwhile, I examine the result when turning to the dependent variable of dummy of R&D investors (R&D>0). The result in column (5) remains consistent with that above, indicating that the change of market orientation from domestic to export type also triggers a higher probability of the drop of R&D investment by exporters. Meanwhile, as the exporters who switch the market orientation account for about 15% over the total sample, the cross-sectional data in 2006 is also employed as the robustness check, and report the results in Table A2.

[9]See Greenaway and Kneller (2007) in detail.

Table 5 Baseline results: the relationship of export orientation and R&D investment of exporter

Dependent variable:	Log R&D investment		Log R&D investment		D(R&D>0)
Sample of:	Total firms	Total exporters	Exporters without processing trade firms		
	(1)	(2)	(3)	(4)benchmark	(5)
Dummy(Export Oriented)		-0.0627**	-0.1067**	-0.1303**	-0.0179**
		(0.0287)	(0.0464)	(0.0521)	(0.0091)
Dummy (Export firm)	0.0244**				
	(0.0119)				
Log (TFP)	0.0800***	0.1447***	0.2264***	0.2575***	0.0285***
	(0.0172)	(0.0255)	(0.0548)	(0.0624)	(0.0105)
Log(Employment)	0.0838***	0.1625***	0.2021***	0.2044***	0.0247**
	(0.0184)	(0.0267)	(0.0603)	(0.0637)	(0.0108)
Firm FEs	Yes	Yes	Yes	Yes	Yes
City-Year FE	Yes	Yes	Yes		
Sector (GBT4)-Year FE	Yes	Yes	Yes		
City-Sector(GBT1)-Year FE				Yes	Yes
Sector (GBT4)-Province-Year FE				Yes	Yes
Observations	69,157	60,867	20,641	20,641	20,641
R-squared	0.79	0.83	0.84	0.87	0.83

Note. This table presents the baseline results of this paper. In column (1), I regress the firms' R&D investment (log) on the dummy of export status. From column (2), I turn to the analysis of export orientation, regressing the R&D investment (log) on the dummy of export orientation status of firms in the sample of total exporters. In the rest of the regressions in Table 5, the processing trade firms whose export value share are higher than 90% are excluded, following Manova and Yu (2016). In column (3) and (4), the dependent variable of R&D investment is employed, while in column (5), the dummy of R&D (>0) is used as dependent variable. Heteroskedasticity-robust standard errors are clustered at the firm level appear in parentheses. ***,**,* Denote significance at the 1%, 5%, and 10% confidence levels, respectively.

C. Robustness checks

In the first part of robustness checks, I test the benchmark result by a set of sample checks. Firstly, the sample of wholly-owned foreign firms is excluded, presuming that foreign firms allocate the innovation activities in the parent countries, instead of the overseas manufacturing centers. Therefore, they manufacture but seldom make innovation in China. I thus exclude them, so as to drop the cases that the negative association of export orientation and R&D investment is due to the multinational firms' allocation strategies of innovation activities in China, the result of which is reported in column (1). Secondly, the state-owned and collective firms could be safe from competition in the markets thanks to some kinds of protection locally, which makes them less pressured to carry out technology improvement and product development. Therefore, I exclude the subsample of state-owned and collective firms, so as to remove the cases that the reduction or even drop in R&D investment is attributed to the local protection instead of the export mode. The result is reported in column (2). Thirdly, I remove the sample of low-tech sectors in terms of the technology classification provided by Lall (2000). As most exports from China belong to low-tech sectors, I drop the sample of them, in order to exclude the possibility that the benchmark is driven in the case that the sectors of high export intensity are just less innovate-intensive. The result is shown in column (3). Similarly, the benchmark result could also be challenged by the competition type of sectors. For the sectors of quality competition attractiveness, firms export higher quality varieties to difficult markets at a higher price, while for the sectors of productivity competition attractiveness, firms with the lower marginal costs manage to export to difficult markets at a lower price. Thus, firms conduct innovation activities mostly in the sectors (products) of quality competition type, investing in R&D in order to improve the quality and differentiation of their products. However, there is a large amount of exporting products of productivity competition type in China. I, therefore, exclude the products of productivity-competition type, in order to avoid that the benchmark result just comes from the exports of price competition attractiveness. I use sector (GBT4 digits) level export data to distinguish quality- from productivity-sorting type, following a procedure suggested by Baldwin and Harrigan (2010).[10] The result is shown in column (4). Additionally, the benchmark result could also be biased when the definition of processing trade firms is inappropriate. Therefore, the alternative definitions of processing trade firms are used, keeping the exporters whose processing trade share is lower than 30% and exporters who export totally under the ordinary trade in column (5) and (6), respectively. The results shown in Table 6 indicate that the benchmark is still held after a set of sensitive samples are excluded, and it is rational that the magnitude of the coefficient on the Dummy (export oriented) enlarges when I exclude the subsamples which are less related to innovation, such as the sectors of low technology products and price-competition type, the firms of foreign and state-owned ownership, as well as the firms under the processing trade regime.

[10] For each sector (GBT4) separately, I regress the average unit value at the country level on the country's attractiveness. If the resulting estimated coefficient is positive and significant at the 10% level, I classify the product as of the productivity-sorting type. If the estimated coefficient is negative and significant at the 10% level, the product is rather considered to be of the quality-sorting type.

Table 6 Robustness checks: sample checks

Dependent variable: log R&D investment						
Subsample:	Excluding FOR firms	Excluding SOE and COL firms	Excluding low-tech products	Excluding price-competition type sectors	Excluding PCS share>30%	Excluding PCS share>0
	(1)	(2)	(3)	(4)	(5)	(6)
Dummy(Export Oriented)	-0.1373**	-0.1314***	-0.2064***	-0.1643***	-0.1171**	-0.1451**
	(0.0587)	(0.0474)	(0.0764)	(0.0538)	(0.0543)	(0.0643)
log (TFP)	0.2687***	0.1954***	0.1759**	0.2056***	0.2318***	0.1932**
	(0.0752)	(0.0584)	(0.0808)	(0.0653)	(0.0656)	(0.0762)
log(Employment)	0.1567**	0.1481**	0.1418	0.1913***	0.1812***	0.1020
	(0.0772)	(0.0590)	(0.0923)	(0.0679)	(0.0670)	(0.0770)
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
City-Sector(GBT1)-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector(GBT4)-Province-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,194	22,564	14,084	17,665	17,812	14,198
R-squared	0.88	0.86	0.87	0.87	0.87	0.87

Note. This table reports the results of sample checks. In column (1), I exclude the wholly owned foreign firms. In column (2), the firms of state-owned and collective types are removed away. In column (3), I drop the low-tech sectors (GBT4), following the technology classification in Lall (2000). In column (4), I keep the sectors (GBT4) of quality-sorting type, following a procedure suggested by Baldwin and Harrigan (2010). In column (5), I drop the processing trade firms in terms of the more strict definition, excluding the firms whose export value share are higher than 90% and processing trade share are higher than 30%. In column (6), I keep the firms whose export value share are lower than 90% and the firms of totally export under the ordinary trade regime. Heteroskedasticity-robust standard errors clustered at the firm level appear in parentheses. ***,**,* Denote significance at the 1%, 5%, and 10% confidence levels, respectively.

Furthermore, the approach of the instrumental variable is employed to investigate the impact of the potential endogenous issue. As discussed in Fernandes and Tang (2014), a firm may learn to export from the neighbors. The neighboring effect is close to the "Anchoring Effect" (Tversky and Kahneman, 1974), which indicates a positive relationship between the firms' export participation and the experience from the surroundings. I thus presume that the shape of export-orientation status is positively correlated with the agglomeration export-oriented exporters in the space nearby. I identify the "neighbors" in the group of city-sector (GBT2) pair following Fernandes and Tang (2014) and use the number of export-oriented firms in the city-sector pair as the IV of the dummy export-oriented firm.

As shown in Table 7, the coefficient on the Dummy (export oriented) remains negative and significant under the IV estimation. The result of the first stage is reported in column (2), showing the positive effect of neighbors on the firms' choice of market orientation, which is consistent with the finding in the literature. The results keep unchanged when the proxy of R&D investment is replaced with the dummy of R&D.

Table 7 Robustness checks: instrumental variable

Dependent variable:	Log R&D investment	Dummy(Export Oriented)	Dummy (R&D >0)	Dummy(Export Oriented)
IV: Number of neighbors in each city-sector (GBT2) group		First stage		First stage
	(1)	(2)	(3)	(4)
Dummy(Export Oriented)	-4.2669**		-0.6739**	
	(2.0820)		(0.3393)	
Nb. Neighbor (city-GBT2)		0.0030***		0.0030***
		(0.0010)		(0.0010)
log (TFP)	0.4130***	0.0486***	0.0560**	0.0483***
	(0.1413)	(0.0158)	(0.0231)	(0.0158)
log(Employment)	0.2703**	0.0198	0.0382**	0.0196
	(0.1065)	(0.0161)	(0.0176)	(0.0161)
log R&D investment		-0.0036*		
		(0.0021)		
Dummy (R&D>0)				-0.0184
				(0.0133)
Firm FEs	Yes	Yes	Yes	Yes
City-Sector(GBT1)-Year FE	Yes	Yes	Yes	Yes
Sector (GBT4)-Province-Year FE	Yes	Yes	Yes	Yes
Observations	17,812	17,812	17,812	17,812
R-squared	0.79	0.81	0.74	0.81

Note. This table provides the results of IV estimation. In the analysis of this part, I drop the processing trade firms in terms of the more strict definition mentioned in column (5) in Table 6, namely, the processing trade share higher than 30%, and the export value share higher than 90%. In column (1), the number of neighbors (firms of export orientation status in the city-sector (GBT2) pair is employed as the instrument variable of the key variable of Dummy (Export Oriented). In column (2), the result of the first stage is reported, showing the relationship between the neighbors and firms' choice of market orientation. In column (3), I replace the dependent variable with the dummy of R&D investor (R&D investment higher than zero), and the corresponding result of the first stage is reported in column (4). Heteroskedasticity-robust standard errors clustered at the city level appear in parentheses. ***,**,* Denote significance at the 1%, 5%, and 10% confidence levels, respectively.

IV. The Role of Demand Uncertainty

I now highlight the link between the market choice on export orientation and the subsequent reduction of R&D investment carried out by exporters, is driven by the demand uncertainty effect in the international market. Towards this end, I employ a set of proxies to explore the demand uncertainty effect from three sides: (1) preference uncertainty induced by the cultural gap between destination countries and China; (2) volatility of demand size in the destination countries; and (3) the economic and financial risks of destination countries. The measurements of demand uncertainty are described in detail in section 3 in this paper. I then estimate the following specification:

$$\log(R\ \&\ D)_{ft+1} = \alpha + \beta \times Dummy\left(Export\ \ Oriented\right)_{ft} + \gamma \times Dummy\left(Export\ \ Oriented\right)_{ft} \times DU_{ft}$$
$$+\delta \times Z_{ft} + \chi'_{\gamma} + \varepsilon_{ft} \qquad (4)$$

The variable of interest is the interaction item of demand uncertainty (DU) and the dummy of export-oriented exporters, where DU is the ex-ante demand uncertainty faced by exporter *f* in year t. A reduction of the firm's R&D investment associated with an ex-ante market choice of export orientation could be induced by the demand uncertainty. The higher demand uncertainty not only increases the chances of making a costly mistake on innovation investment decision when the market size is more volatile (Guiso and Parigi, 1999; Bloom, 2007; Bloom et al., 2007), but also plays as an additional sunk cost for exporters when the information asymmetry of demand preference is higher (Morales et al., 2014; Fernandes and Tang, 2014). Therefore, I predict that the export-oriented firms are prone to reducing the R&D investment or even drop any efforts on R&D, when they export mostly toward the destination countries of higher demand uncertainty.

A. Demand uncertainty effect induced by the cultural gap

The results of demand uncertainty effect induced by the cultural gap are shown in Table 8. From column (1) to (4), we regress the log R&D investment on the interaction term of the export orientation status and the demand uncertainty measured based on the cultural gap resulting from the different language, non-common history of same country, territories located in different continent and even different gene of population between the destination countries and China. Furthermore, as shown in column (5) to (8), the coefficients yield very similar results when I examine the impact of the probability of making R&D investment or not. The coefficients on the interaction terms of the export orientation status and the proxies of demand uncertainty (DU) are significantly negative, while the coefficients on the dummy of export-oriented firm are positive. The results indicate that the negative impact of export orientation on the R&D investment (the probability of making R&D investment) lies in the exporting to the destination countries of cultural differentiation with China. Meanwhile, the coefficients on the dummy of export-oriented firm are positive and significant, implying that in the case of lower demand uncertainty, the export orientation status is indeed correlated with a higher level of R&D investment handled by firms, which is consistent with the findings of "export induced innovation" in the literature.

Table 8 Demand uncertainty effect induced by cultural gap

Dependent variable:	log R&D investment				Dummy (R&D>0)			
Proxies of demand uncertainty (DU):	Export value share of exporting to the destinations of **non-common:**							
	language (1)	history (2)	continent (3)	gene (4)	language (5)	history (6)	continent (7)	gene (8)
Dummy(Export Oriented)	0.84***	0.81**	0.82**	0.60**	0.12**	0.12*	0.14**	0.10*
	(0.32)	(0.33)	(0.33)	(0.28)	(0.06)	(0.06)	(0.06)	(0.05)
X DU (language)	-0.99***				-0.14**			
	(0.35)				(0.07)			
X DU (history)		-0.94***				-0.14**		
		(0.35)				(0.07)		
X DU (continent)			-0.97***				-0.16**	
			(0.36)				(0.07)	
X DU (Gen)				-0.84**				-0.14**
				(0.35)				(0.07)
DU (language)	0.14				0.01			
	(0.61)				(0.09)			
DU (history)		-0.13				0.01		
		(0.83)				(0.13)		
DU (continent)			-1.51				-0.23	
			(1.32)				(0.22)	
DU (Gen)				0.26				-0.01
				(0.84)				(0.13)
log (TFP)	0.20***	0.20***	0.20***	0.20***	0.02**	0.02**	0.02**	0.02**
	(0.06)	(0.06)	(0.06)	(0.06)	(0.01)	(0.01)	(0.01)	(0.01)
log(Employment)	0.16***	0.16***	0.16***	0.16***	0.02**	0.02**	0.02**	0.02**
	(0.06)	(0.06)	(0.06)	(0.06)	(0.01)	(0.01)	(0.01)	(0.01)
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City-Sector(GBT1)-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector (GBT4)-Province-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,776	18,776	18,776	18,776	18,776	18,776	18,776	18,776
R-squared	0.84	0.84	0.84	0.84	0.79	0.79	0.79	0.79

Note. This table reports the results of demand uncertainty effect induced by the cultural gap. All the regressions are done in the sample without firms whose export value share is higher 90%, as well as firms whose processing trade value share over total exports, is higher than 50%. From column (1) to (4), the proxies of demand uncertainty are employed by the export share of exporting to the destinations of different language, history, continent and gene source from parent countries. In column (5) to (8), I redo the regressions with the dependent variables of dummy (R&D >0). Heteroskedasticity-robust standard errors clustered at the firm level appear in parentheses. ***, **,* Denote significance at the 1%, 5%, and 10% confidence levels, respectively.

B. Demand uncertainty effect induced by the market volatility

Then, I explore the demand uncertainty effect induced by the volatility of demand size in the target markets abroad, which is measured based on the dispersion of GDP and GDP per capita in the destination countries. A larger dispersion of GDP and PGDP is associated with a higher degree of market size and income volatility, which therefore increases the demand uncertainty faced by exporters. Hence, the coefficient on the interaction term of demand uncertainty proxies based on the dispersion of GDP (PGDP) and the dummy of export-oriented firms is expected to be negative.

As shown in Table 9, in column (1) and (2), I regress the log R&D investment on the interaction term of export-orientation status and the demand uncertainty induced by the volatility of market size (standard deviation of GDP) and the differentiation of preference (standard deviation of GDP per capita). The coefficients on the interaction term are significantly negative, while the coefficients on the dummy of export oriented firm are positive, which robustly shows that firms are prone to reduce the R&D investment or even stop innovation effort when exporting mostly to the destination countries of higher volatility of market size.

Table 9 Demand uncertainty effect induced by the volatility of GDP and income

Dependent variable:	log R&D investment		Dummy (R&D>0)	
Proxies of demand uncertainty (DU):	Export value share of exporting to the destinations of **:**			
	High Disp. GDP	High Disp. PGDP	High Disp. GDP	High Disp. PGDP
	(1)	(2)	(3)	(4)
Dummy(Export Oriented)	0.75**	0.57**	0.13*	0.10**
	(0.35)	(0.27)	(0.07)	(0.05)
X DU (High Disp. GDP, S.D.)	-0.85**		-0.14**	
	(0.36)		(0.07)	
X DU (High Disp. PGDP, S.D.)		-0.75**		-0.13**
		(0.31)		(0.06)
DU (GDP S.D.)	2.19		0.32	
	(2.57)		(0.39)	
DU (PGDP S.D.)		-0.30		-0.06
		(0.56)		(0.09)
log (TFP)	0.20***	0.20***	0.02**	0.02**
	(0.06)	(0.06)	(0.01)	(0.01)
log(Employment)	0.16***	0.16***	0.02**	0.02**
	(0.06)	(0.06)	(0.01)	(0.01)
Firm FEs	Yes	Yes	Yes	Yes
City-Sector(GBT1)-Year FE	Yes	Yes	Yes	Yes
Sector(GBT4)-Province-Year FE	Yes	Yes	Yes	Yes
Observations	18,776	18,776	18,776	18,776
R-squared	0.84	0.84	0.79	0.79

Note. This table reports the results of demand uncertainty effect induced by the volatility of market size. All the regressions are done in the sample without firms whose export value share is higher 90%, as well as firms whose processing trade value share over total exports is higher than 50%. The proxies of demand uncertainty are measured based on by the export share exporting to the destination of higher dispersion of GDP and GDP per capita. In Table 9, the dispersion is estimated in terms of the standard deviation of GDP (PGDP) in the first ten-year period before the first year of the sample. The measurement of dispersion based on the inter-decile (between 25 percentile and 75 percentile) and the gap between maximum and minimum are as robustness checks. Heteroskedasticity-robust standard errors clustered at the firm level appear in parentheses. ***,**,* Denote significance at the 1%, 5%, and 10% confidence levels, respectively.

Moreover, I also estimate the proxies of GDP and PGDP dispersion based on the inter-decile (between 25 percentile and 75 percentile) and the gap between maximum and minimum of GDP per capita of destination countries. The results above remain unchanged.

C. Demand uncertainty effect induced by the country risk

Furthermore, I employ a set of indices about country risks provided by ICRG as the proxies of demand uncertainty in the foreign markets. The measurements on these indices are described above. The previous development level of each country allows exporters to predict the aggregative prospects of their targeted markets, and generally, the higher uncertainty faced by exporters increase when the development tendency in the destination countries is unprosperous. Hence, I expect that the interaction term of Dummy (Export Oriented) and the proxies of demand uncertainty measured based on the high country risks is negative.

As shown in Table 10, in column (1), I regress the interaction term of the export-oriented firm and the proxy of demand uncertainty (DU), the latter of which is estimated based on the economic risks of the destination countries. The coefficient on the interaction terms is significantly negative. In column (2), I turn to use the financial risks, the sign of coefficients of the interaction term remains negative, indicating that the unpromising and unsteady development tendency of destination countries enlarges the difference of R&D investment and R&D intensity between export-oriented and domestic-oriented exporters. In column (3) and (4), I redo the regressions using the dependent variable of whether making R&D investment or not. The results keep consistent that the probability of investing in R&D reduces when firms export to the destination countries of higher economic and financial risks.

Table 10 Demand uncertainty effect induced by the country risks

Dependent variable:	log R&D investment		Dummy (R&D>0)	
Proxies of demand uncertainty (DU):	Export value share of exporting to the destinations of :			
	High Eco. risks	High Fin. risks	High Eco. risks	High Fin. risks
	(1)	(2)	(3)	(4)
Dummy(Export Oriented)	0.29*	0.13	0.05**	0.03
	(0.15)	(0.13)	(0.03)	(0.02)
X DU (High economic risks)	-1.25**		-0.21**	
	(0.50)		(0.09)	
X DU (High financial risks)		-0.87*		-0.16*
		(0.52)		(0.09)
DU (High economic risks)	-0.21		0.08	
	(0.66)		(0.11)	
DU (High financial risks)		-0.13		0.04
		(0.48)		(0.08)
log (TFP)	0.20***	0.20***	0.02**	0.02**
	(0.06)	(0.06)	(0.01)	(0.01)
log(Employment)	0.16***	0.16***	0.02**	0.02**
	(0.06)	(0.06)	(0.01)	(0.01)
Firm FEs	Yes	Yes	Yes	Yes
City-Sector(GBT1)-Year FE	Yes	Yes	Yes	Yes
Sector (GBT4)-Province-Year FE	Yes	Yes	Yes	Yes
Observations	18,776	18,776	18,776	18,776
R-squared	0.84	0.84	0.79	0.79

Note: This table reports the result of demand uncertainty effect induced by the country risks. All the regressions are done in the sample without firms whose export value share is higher 90%, as well as firms whose processing trade value share over total exports, is higher than 50%. The proxies of demand uncertainty are measured based on the export share exporting to the destination of higher economic and financial risks. Heteroskedasticity-robust standard errors clustered at the firm level appear in parentheses. ***, **,* Denote significance at the 1%, 5%, and 10% confidence levels, respectively.

D. Dynamics of demand uncertainty effect

As the literature documents that exporting experience plays the positive role on relieving the demand shock by exporters' accumulation of demand information in the foreign markets (Sheard, 2014; Céline Carrère, 2014; Fernandes and Tang, 2014), I then explore the change of demand uncertainty effect along with the increasing of firms' exporting experience.

I reproduce the benchmark regression in column 4 of Table 5, but now decompose the Dummy(Export Oriented) into several dummies in terms of the period between the first year exporters engaging in exporting and the year t ($I_f^{t-Birthyear_f=n}$). The combined firm-level data covers the exporting transaction data starting from 2000 (start to export from or before 2000), therefore, the range of the exporting year between the year t and the birth year of one exporter is from zero to six. The dummy denoted by *Dummy export-oriented (new exporter)* equals to one when the number of exporting year is at most three years and zero otherwise, while the dummy denoted by *Dummy export-oriented (old exporter)* equals to one when firms start the exporting activity at least four years before the year t and zero otherwise. I expect that the demand uncertainty effect could be weakened when the uncertainty induced by information asymmetry could be relieved by exporting experience. The estimation specification is as follows:

$$logR\&D_{ft+1} = \sum_n \alpha_n \times (Dummy(Export\ Oriented)_f^{t-Birthyear_f=n} + \sum_n [\rho_n \times (Dummy(Export\ Oriented)_f^{t-Birthyear_f=n} \times DU_{ft})]$$

$$+\delta Z_{ft} + \chi'_{\gamma} + \xi_{ft} \tag{5}$$

Table 11 The demand uncertainty effect under the rich exporting experience

Dependent variable:	log R&D investment			
Proxies of demand uncertainty (DU)	Export value share in the destinations of :			
	Different language	Different history	Different geographic location	High market volatility
	(1)	(2)	(3)	(4)
Dummy export-oriented (new) X DU	-1.17**	-1.12*	-1.44**	-1.08**
	(0.58)	(0.59)	(0.58)	(0.46)
Dummy export-oriented (old) X DU	0.05	0.18	-0.18	-0.45
	(0.92)	(0.92)	(0.92)	(0.74)
Dummy export-oriented (new)	0.92*	0.89	1.16**	0.75*
	(0.54)	(0.55)	(0.54)	(0.39)
Dummy export-oriented (old)	-0.32	-0.45	-0.13	0.09
	(0.86)	(0.87)	(0.86)	(0.65)
log (TFP)	0.20***	0.20***	0.20***	0.20***
	(0.07)	(0.07)	(0.07)	(0.07)
log(Employment)	0.18***	0.18***	0.18***	0.18***
	(0.07)	(0.07)	(0.07)	(0.07)
Firm FEs	Yes	Yes	Yes	Yes
City-Sector(GBT1)-Year FE	Yes	Yes	Yes	Yes
Sector (GBT4)-Province-Year FE	Yes	Yes	Yes	Yes
Observations	17,863	17,863	17,863	17,863
R-squared	0.85	0.85	0.85	0.85

Note: This table reports the result of dynamic demand uncertainty effect along with the increase in firms' exporting experience. All the regressions are done in the sample without firms whose export value share is higher 90%, as well as firms whose processing trade value share over total exports, is higher than 50%. The variable of export-oriented firm dummy is separated into two parts of Dummy export-oriented (new) and Dummy export-oriented (old), the former of which are those of exporting experience less than three years, and the latter are those of exporting experience of at least three years. The proxies of demand uncertainty are measured based on by the firm's export share exporting to the destination of different language, no history of the same country and geographical location of the different continent from China, and the higher market volatility. Heteroskedasticity-robust standard errors clustered at the firm level appear in parentheses. ***, **,* Denote significance at the 1%, 5%, and 10% confidence levels, respectively.

As shown in Table 11, I regress the log R&D investment on the interaction term of DU and export-oriented firms who are separated into two groups, namely new exporters of exporting experience for at most three years and the rest. In column (1) to (4), I employ the demand uncertainty proxies of different language, history, geographical location between destination countries and China, and the higher market volatility in the destination countries, while that of the old export oriented firms turn to be insignificant. The results keep unchanged when I use the different cut-off of new exporters, the results of which are reported in Table A3 in the appendix. Hence, the demand uncertainty seems to be reinforced when firms enter new markets, while be attenuated in the case of firms with richer international experience.

V. Responses of Heterogeneous Firms under the Demand Uncertainty

Graphically the right-hand side panel in Figure 1 shows that the R&D investment increases much more along with the rise of the percentile of firms' productivity and scale. Quantitatively Table 12 reports the results, showing how the high productivity firms do different innovation behaviors as the responses to the international demand uncertainty effect. I regress the log R&D investment on the triple interaction term of export orientation dummy, the proxy of demand uncertainty and the dummy of firms of high productivity. The specification is as follows:

$$\log(R\,\&\,D)_{ft+1} = \alpha + \beta \times Dummy\left(Export\ \ Oriented\right)_{ft} + \gamma \times Dummy\left(Export\ \ Oriented\right)_{ft} \times DU_{ft} \times Dummy(High\ \ TFP) + \delta Z_{ft} + \chi'_{\gamma} + \varepsilon_{ft} \tag{6}$$

As shown in Table 12, the coefficients on the interaction terms of demand uncertainty proxies and export orientation dummy show the consistency of the demand uncertainty effect that an ex-ante increasing demand uncertainty in the destination market brings about a subsequent decreasing R&D investment averagely. However, the coefficients on the triple interaction terms robustly show that the impacts of demand uncertainty on the R&D investment turn to be positive at the firm-level productivity around the seventh decile. The results keep unchanged no matter the proxies of demand uncertainty are measured based on the cultural diversity, market volatility and potential economic risks of the destination countries. Hence, the results indicate that innovation activity is conducted by a minority of exporters who are initially of high productivity, which allows them to participate in innovation by overcoming the cost under the international environment of uncertainty.

Table 12 Productivity requirement of innovation under the high uncertainty

Dependent variable:	log R&D investment			
Proxies of demand uncertainty (DU)	Export value share of exporting to the destinations of :			
	Different language	High Disp. GDP	High Disp. PGDP	High Eco. risks
	(1)	(2)	(3)	(4)
Dummy(Export Oriented)	0.79*	0.77	0.72*	0.17
	(0.48)	(0.48)	(0.39)	(0.19)
Dummy(Export Oriented) X DU X D (high TFP)	1.52**	1.72**	1.47**	1.82**
	(0.70)	(0.71)	(0.70)	(0.92)
Dummy(Export Oriented) X DU	-0.95*	-0.91*	-0.95**	-0.78
	(0.51)	(0.51)	(0.46)	(0.53)
DU X D (high TFP)	-4.16	-5.14	-0.27	-0.04
	(3.75)	(2.47)	(1.17)	(0.78)
Dummy(Export Oriented) X D (high TFP)	-1.38*	-1.57	-1.20*	-0.63
	(0.74)	(0.84)	(0.58)	(0.36)
DU	1.69	1.29	-0.09	0.76
	(2.33)	(1.59)	(0.78)	(0.54)
log(Employment)	0.19***	0.19**	0.19***	0.19***
	(0.07)	(0.07)	(0.07)	(0.07)
Firm FEs	Yes	Yes	Yes	Yes
City-Sector(GBT1)-Year FE	Yes	Yes	Yes	Yes
Sector (GBT4)-Province-Year FE	Yes	Yes	Yes	Yes
Observations	17,723	17,723	17,723	17,723
R-squared	0.87	0.87	0.87	0.87

Note: This table reports the result of the innovation responses of firms with heterogeneous TFP level to the international demand uncertainty. All the regressions are done in the sample without firms whose export value share is higher 90%, as well as firms whose processing trade value share over total exports, is higher than 50%. I use the 70^{th} percentile of log TFP as the cut-off of high productivity firms. High dispersion of GDP and GDP per capita is measured based on the inter-decile between the 75^{th} percentile and 25^{th} percentile of GDP (PGDP). Heteroskedasticity-robust standard errors clustered at the firm level appear in parentheses. ***, **,* Denote significance at the 1%, 5%, and 10% confidence levels, respectively.

VI. Conclusion

This paper has contributed to the analysis of export-innovation nexus. I analyze the impact of export orientation on the R&D investment of Chinese firms. By exploring the combined firm-level datasets between the "Annual Survey of Chinese Industrial Firms" (ASIF) and the Chinese Customs Trade Statistics (CCTS), I find robustly that firms changing from the status of non-exporter to exporters are accompanied by the increase in R&D investment, whereas firms reduce the innovation efforts when switching from domestic-oriented to export-oriented type. The results remain robust in a set of robustness checks, such as the IV approach and the exclusion of processing trade firms. The lower level of R&D investment is particularly pronounced in the case of export activities subject to the demand uncertainty. By measuring the firm-level demand uncertainty based on the cultural gap between destination countries and China, the volatility of market size and the economic and financial risks of destination countries, I investigate the role of demand uncertainty in the negative association of export orientation and demand uncertainty. I find the significantly negative coefficient on interaction term of export orientation and demand uncertainty, indicating that the underperformance in the innovation of firms whose sales are primarily oriented towards international markets is strengthened when their activities are characterized by high uncertainty in international markets. The negative effect induced by demand uncertainty lies especially when firms enter a new market, while attenuates in the case of firms with richer exporting experience when the information asymmetry is relieved. Furthermore, the innovation behavior of heterogeneous firms reacting to the demand uncertainty is different: R&D investment increases even if under the condition of high uncertainty for initially more productive firms, while the effect is reversed for less productive firms as the negative uncertainty effect dominates, which implies there is a higher productivity requirement of innovation than exporting for firms so as to overcome the additional fixed cost such as uncertainty in the international markets.

Appendix

Table A1 Summary of variables

Variable	Mean	Std. Dev.	Min	Max
Log R&D investment	1.05	2.49	0.00	15.78
Dummy (R&D >0)	0.17	0.38	0.00	1.00
Dummy(Export Oriented)	0.65	0.48	0.00	1.00
Log TFP	4.55	0.83	0.02	9.35
Log NB. employee	5.39	1.08	2.08	11.02
DU(High. economic risk)	0.26	0.09	0.00	1.00
DU(High. financial risk)	0.20	0.08	0.00	1.00
DU(S.D.,GDP)	0.72	0.14	0.00	1.00
DU(inter-decile, GDP)	0.73	0.14	0.00	1.00
DU(Max-Min, GDP)	0.72	0.14	0.00	1.00
DU(S.D.,PGDP)	0.81	0.17	0.00	1.00
DU(inter-decile, PGDP)	0.81	0.17	0.00	1.00
DU(Max-Min, PGDP)	0.81	0.17	0.00	1.00
DU(Diff. language)	0.90	0.16	0.00	1.00
DU(Diff. continent)	0.92	0.16	0.00	1.00
DU(Diff. history)	0.89	0.16	0.00	1.00
DU(Diff. gen)	0.81	0.16	0.00	1.00

Note: Table A1 reports the statistics of variables using in the empirical analysis in this paper.

Table A2 The relationship of export orientation and R&D investment of exporter (cross section data in 2006)

Dependent variable:	Log R&D investment			Dummy(R&D>0)
Sample of:	Total firms	Total exporters	Exporters without PCS	Exporters without PCS
	Exporter VS non-exporter	EXPO VS DOMO	EXPO VS DOMO	EXPO VS DOMO
	(1)	(2)	(3)	(4)
Dummy (Export firm)	0.2970***			
	(0.0282)			
Dummy(Export Oriented)		-0.4274***	-0.2466***	-0.0256***
		(0.0512)	(0.0608)	(0.0096)
Log (TFP)	0.2880***	0.4095***	0.4390***	0.0384***
	(0.0232)	(0.0448)	(0.0656)	(0.0082)
Log(Employment)	0.5203***	0.6270***	0.8636***	0.1092***
	(0.0190)	(0.0460)	(0.0405)	(0.0053)
City FE	Yes	Yes	Yes	Yes
Province-Sector FE	Yes	Yes	Yes	Yes
Company type FE	Yes	Yes	Yes	Yes
Observations	192,236	25,014	12,125	12,125
R-squared	0.26	0.36	0.42	0.36

Note. This table reports the results of the relationship between export orientation and R&D investment of firms. All the regressions in Table A2 have been done employing the cross-section data in 2006. In column (1), I regress the firms' R&D investment (log) on the dummy of export status, in order to show the consistent result with the existing literature, namely a positive R&D investment premium from the participation of exporting. From column (2), I turn to the analysis of export orientation, regressing the R&D investment (log) on the dummy of export orientation status of firms in the sample of total exporters. In the rest of regressions in Table A2, I exclude the processing trade firms whose export value share are higher than 90%, following Manova and Yu (2016). In column (3) and (4), the dependent variables of R&D investment and the dummy of R&D (>0) are employed, respectively. Heteroskedasticity-robust standard errors are clustered at the firm level appear in parentheses. ***,**,* Denote significance at the 1%, 5%, and 10% confidence levels, respectively.

Table A3 The demand uncertainty effect under the rich exporting experience (different cut-off)

Dependent variable:	log R&D investment			
Proxies of demand uncertainty (DU)	Export value share in the destinations of :			
	Different language	Different history	Different geographic location	High market volatility
	(1)	(2)	(3)	(4)
Dummy EXPO (new) X DU	-1.16**	-1.12*	-1.45**	-1.04**
	(0.58)	(0.59)	(0.58)	(0.46)
Dummy EXPO (middle) X DU	-1.14*	-1.07	-1.43**	-0.98*
	(0.68)	(0.69)	(0.69)	(0.52)
Dummy EXPO (old) X DU	-0.78	-0.64	-1.15	-0.94
	(0.95)	(0.96)	(0.96)	(0.75)
Dummy EXPO (new)	0.90*	0.87	1.16**	0.70*
	(0.54)	(0.55)	(0.54)	(0.40)
Dummy EXPO (middle)	0.81	0.75	1.06*	0.59
	(0.64)	(0.65)	(0.64)	(0.46)
Dummy EXPO (old)	0.37	0.25	0.69	0.46
	(0.90)	(0.91)	(0.90)	(0.67)
log (TFP)	0.20***	0.20***	0.20***	0.20***
	(0.07)	(0.07)	(0.07)	(0.07)
log(Employment)	0.18***	0.18***	0.18***	0.18***
	(0.07)	(0.07)	(0.07)	(0.07)
Firm FEs	Yes	Yes	Yes	Yes
City-Sector(GBT1)-Year FE	Yes	Yes	Yes	Yes
Sector (GBT4)-Province-Year FE	Yes	Yes	Yes	Yes
Observations	17,863	17,863	17,863	17,863
R-squared	0.85	0.85	0.85	0.85

Note: This table reports the result of dynamic demand uncertainty effect along with the increase of firms' exporting experience. All the regressions are done in the sample without firms whose export value share is higher 90%, as well as firms whose processing trade value share over total exports, is higher than 50%. The variable of export-oriented firm dummy is separated into three parts of Dummy EXPO (new), Dummy EXPO (middle) and Dummy EXPO (old), the new of which are those of exporting experience less than two years, the middle of which are those of exporting experience at least two years and at most four years, and the old are those of exporting experience of at least four years. The proxies of demand uncertainty are measured based on by the firm's export share exporting to the destination of the different language, no history of the same country and geographical location of different continent from China, and the higher market volatility. Heteroskedasticity-robust standard errors clustered at the firm level appear in parentheses. ***, **,* Denote significance at the 1%, 5%, and 10% confidence levels, respectively.

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Titre : **Répercussions et déterminants de la qualité des exportations en Chine**

Résumé
Cette thèse se compose de trois chapitres ayant en commun la question de la qualité des exportations dans un contexte de pays en voie de développement. La thèse s'intéresse plus particulièrement à différents aspects permettant d'améliorer le niveau de qualité des exportations. Le premier chapitre est consacré à l'impact de l'Aide au commerce (Aid for trade) sur la qualité des exportations des pays récipiendaires. Il suggère un effet positif de la politique d'aide au commerce sur la qualité des exportations. Le deuxième chapitre porte sur le rôle de vérification de la qualité joué par les intermédiaires dans le commerce international. Les résultats indiquent que seuls les intermédiaires spécialisés jouent ce rôle. Le troisième chapitre examine le lien entre l'orientation à l'exportation des entreprises et leur performance en matière d'innovation. L'analyse empirique met en évidence une réduction des investissements en R&D chez les exportateurs dont les ventes s'orientent principalement vers les exportations au détriment du marché intérieur et ce d'autant plus qu'ils font face à une incertitude élevée de la demande. Ces évolutions défavorables pourraient être surmontées néanmoins si l'entreprise a une riche expérience commerciale ou une productivité élevée. Les trois résultats principaux de cette thèse sont ainsi que l'aide au commerce ainsi que l'essor d'intermédiaires de type spécialisé contribuent à la montée en qualité des exportateurs tandis que l'incertitude de la demande extérieure tend à l'inverse à entraver l'innovation des firmes exportatrices.

Mots-clés en français :
Qualité des exportations, aide au commerce, intermédiaires commerciaux, incertitude de la demande, innovation.

Title : **Repercussions and Determinants of Export Quality : Evidence from China**

Summary :
This thesis is composed of three chapters that have in common the question of export quality in a developing country context. The thesis focuses on different aspects of improving the quality level of exports. The first chapter is devoted to the impact of Aid for Trade on the quality of exports from recipient countries. It suggests a positive effect of Aid for Trade policy on the quality of exports. The second chapter focuses on the quality assurance role played by intermediaries in international trade. The results indicate that only specialized intermediaries play this role. The third chapter examines the link between firms' export orientation and their innovation performance. The empirical analysis shows a reduction in R&D investment by exporters whose sales reorient towards exports to the detriment of the domestic market, especially as they face high demand uncertainty. These unfavourable developments could nevertheless be overcome if the company has a long trade experience or high productivity. The three main results of this thesis are that aid for trade and the rise of specialized intermediaries contribute to the rise in quality of exporters, while the uncertainty of external demand tends, on the other hand, to hinder innovation by exporting firms.

Keywords :
Export quality, aid for trade, trade intermediaries, demand uncertainty, innovation.