

Innovation with Global Firms

Discussion of Past, Present and Future of European Productivity by Antonin Bergeaud

By Kalina Manova¹

Abstract

The past, present and future of European productivity is as multi-faceted as it is fundamental to economic prosperity in Europe. Antonin Bergeaud provides a sweeping overview of a vast literature, which he complements with original analysis. This discussion offers a global perspective and a globalization perspective on European productivity with three key messages. First, globalization creates opportunities for growth and innovation, but seizing those opportunities requires capable firms, efficient markets, and strong institutions. Second, economic policy and analysis need to stay firmly focused on firms as the main decision makers. And third, globalization engenders or reinforces policy spillovers that matter for the design and impact of economic policy. I close with two open questions: the relationship between growth and growth+++ objectives of inequality, resilience and sustainability, and holistic policy thinking in light of rapid technological change.

1 A global(ization) perspective on European productivity

The past, present and future of European productivity is as multi-faceted as it is fundamental to economic prosperity in Europe. Antonin Bergeaud provides a sweeping overview of a vast literature, which he complements with original analysis. He offers rich insights that stand on rigorous foundations, and places the complex evolution of European productivity in its economic and geopolitical context. The past shows alternating periods of not only common productivity fluctuations, but also of both rapid technological progress and slowdown. It is marked by sometimes leading the frontier, sometimes falling behind, and sometimes catching up. The present is notably mixed, with points of strength as much as causes for concern. The future is thus arguably uncertain, but with definite pillars of promising technological prospects that require evidence-based policy making focused on the long run.

This discussion offers a global perspective and a globalization perspective on European productivity. While globalization may be under fire on today's geopolitical stage, the world is more interconnected and interdependent than ever before, with all

¹ University College London and CEPR. I thank my co-authors for their invaluable contribution to our projects, and acknowledge support from The Leverhulme Trust and ERC Horizon 2020 (Consolidator Grant Agreement 724880) for some of the research cited.

the positives and negatives this might entail. It is thus doubly important to recognize the economics of how globalization shapes productivity and economic growth.

I emphasize three messages. First, globalization creates opportunities for growth, but seizing those opportunities requires capable firms, efficient markets, and strong institutions. Second, economic policy and analysis need to stay firmly focused on firms. While we care about aggregate outcomes and macroeconomic policy, firms are the economic agents that make decisions and take actions. Economic policy and its analysis should thus recognize the role of heterogeneous firms in a global context. And third, globalization engenders or reinforces policy spillovers that matter for the design and impact of economic policy. Input-output linkages among firms, sectors, and countries create interdependent effects across policies (e.g. industrial, investment, innovation, trade), as well as spillovers of not only multilateral but also behind-the-border policies across countries.

I develop these points as follows. Section 2 gives a bird's-eye view on key globalization features in relation to trade, growth, and innovation. Section 3 offers an organizing conceptual framework for how globalization can both (a) improve firm performance at given productivity and (b) boost firm innovation and productivity. It also identifies key firm, market, and institutional prerequisites for capitalizing on these opportunities. Sections 4 and 5 take a pointillistic approach to illustrating (a) and (b), respectively, by highlighting key takeaways from some of my research projects with co-authors. Section 6 closes with two focal open questions: the relationship between growth on the one hand and inequality, resilience and sustainability on the other hand – what I call “growth+++” objectives; and holistic policy thinking given rapid technological change.

While the discussion moves swiftly through ideas and evidence, further details are available through the associated academic papers.²

2 Key globalization features

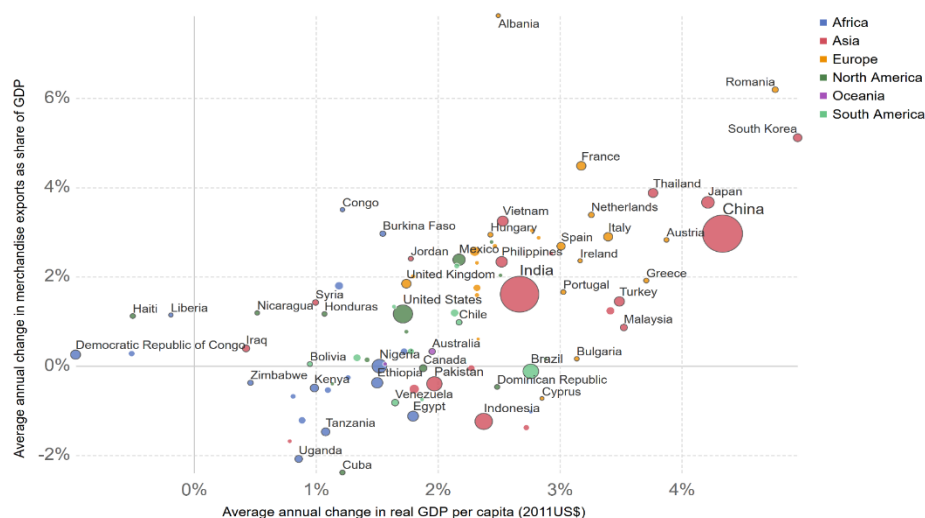
2.1 Globalization and growth: 20th vs. 21st century

The relationship between globalization and growth is well understood and easy to summarize for the 20th century. Extensive academic evidence indicates that countries more open to international trade grew significantly faster over the long run. This stands out clearly in Chart 1 for the post-war period after 1945: Countries with a higher average annual growth rate of merchandise exports as a share of GDP also experience higher average annual growth in GDP per capita.

² A recording of this discussion is available at [SINTRA ECB Forum 2024](#). All my academic papers can be accessed [here](#).

Chart 1**Growth of income and trade, 1945 to 2014**

(average annual change in real GDP per capita vs average annual change in export volumes)



Source: Fouquin and Hugot (CEPII 2016), Maddison Project Database (2018), Population (Gapminder, HYDE (2016) & UN (2019)).

Technological change and trade policy have fundamentally transformed the landscape of international trade and investment in the 21st century. The drastic reduction in shipping, communication, and tariff costs by the end of the 20th century enabled the rise of global value chains and multinational activity at the turn of the new century. It is now all about ships and chips. These developments have been accompanied by deepening financial and labor market integration across most of the world.

The two concepts that best capture the key features of globalization in the 21st century are thus interconnectedness and interdependence, with all the positive and negative economic and geopolitical implications these might call to mind.

The changing pace and face of globalization have triggered intensified policy debates, and brought global cooperation under fire in recent years. This reflects distinct challenges across countries of asymmetric economic development, market structures, and institutional strength. In advanced economies, while aggregate welfare gains may be well recognized, there have been concerns about the rise in inequality in the context of competition from countries with low wages or different economic structures. In developing and emerging economies, even more fundamental questions have surfaced about the mixed gains from globalization in the context of weak institutions and misallocation.

2.2 Global value chains and global innovators

Production fragmentation across firm boundaries and country borders has unbundled different stages of the production process such as R&D, product design, input manufacturing, product assembly, marketing, and distribution. In particular, global

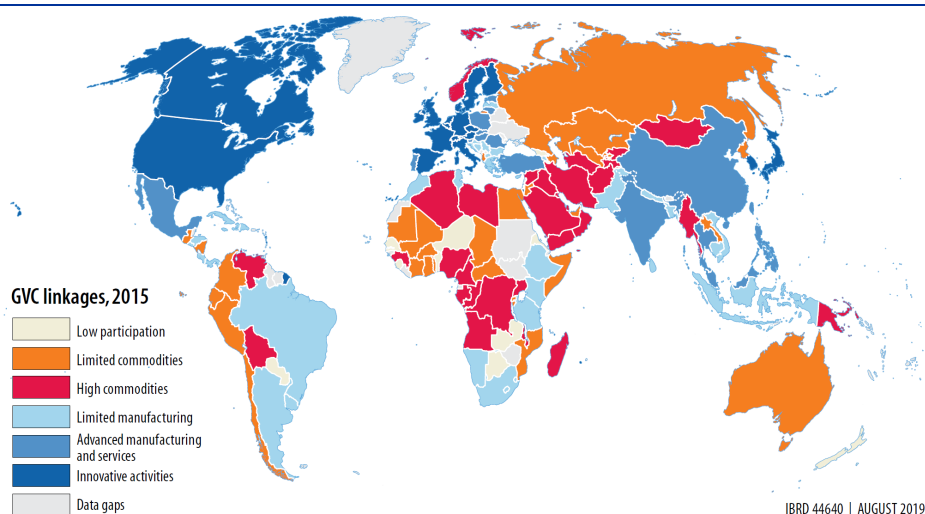
production networks today are characterized by complex, multi-stage linkages among highly heterogeneous buyers and suppliers.

Today, about 70-80% of world trade is estimated to be in intermediate inputs for further processing, domestic production or re-exporting. The share of global trade flows that cross more than one national border before reaching final consumers has risen from approximately one third to approximately half between 1970 and 2015 (World Development Report 2020).

Multinational companies (MNCs) have been instrumental in the expansion of global value chains (GVCs). MNCs conduct about 70-80% of world trade, which is believed to be evenly split between within-firm transactions among affiliates of the same parent company and arm's-length transactions between an MNC and its independent buyers or suppliers.

Figure 1 shows a map of the world from the 2020 World Bank's World Development Report. It classifies countries into broad GVC positions as of 2015, based on the extent of their GVC participation, the sectoral composition of their trade activity, and their engagement in innovation.

Figure 1
GVC participation across countries, 2015



Source: WDR 2020 team, based on the taxonomy for 2015 (see box 1.3 in chapter 1).
Notes: The type of a country's GVC linkages is based on (1) the extent of its GVC participation, (2) its sectoral specialization in trade, and (3) its engagement in innovation. Details are provided in figure 1.6 in chapter 1.

This map paints a familiar picture: Many developing countries in Central Asia, South America and Africa are still focused on limited to high engagement in commodities, while most of South America and parts of South East Asia are active in limited manufacturing stages. While Europe, North America and Japan dominate in innovative activities, much of South East Asia has transitioned into advanced manufacturing stages and services.

Recent globalization and technological developments mean that the landscape of world innovation is changing, and changing fast. In the 20th century, global innovation activity was concentrated in advanced economies in the global West.

Western-headquartered multinationals conducted the vast majority of world R&D in the West, pushing the global technological frontier, and deploying these technologies globally. Their international production operations helped mediate knowledge transfer to the global South, which aspired to adopt and adapt technologies in an attempt to catch up to the frontier.

In the 21st century, advanced economies still lead world innovation overall, but innovation at the frontier increasingly happens across the globe. Pioneers in emerging economies now frequently leapfrog their Western competitors. For example, at the peak of the COVID pandemic, Chinese company AutoX secured permits for driverless tests in California in July 2020, and was the first to trial driverless taxis on the streets of San Francisco in December 2020. They bet US competitor Waymo to the punch, who launched their robotaxi service only in August 2021.

3 Globalization for growth

Globalization has first-order effects on economic growth and innovation activity. A large literature has examined the multiple channels through which these effects may operate and interact with each other, and provided both reduced-form evidence and model-based quantification of the magnitudes. Here I provide an overview of why globalization matters for the evolution of productivity as an organizing framework for thinking through these forces.

Globalization and global production fragmentation can put firms on a steeper growth path through two distinct channels: It can improve firm performance given firms' own productivity and production practices. In addition, it can also improve firm productivity through innovation and technological upgrading. However, capitalizing on these global growth opportunities necessitates certain prerequisites: strong firm capabilities, efficient markets, and well-functioning institutions.

3.1 Globalization can improve firm performance at given productivity

Access to global markets can enable firms to improve their revenue and profit performance at their given productivity level, even without changing their production technology or engaging in innovation.

First, global sourcing allows firms to lower their marginal production cost or upgrade their output quality. In particular, lower import barriers facilitate access to intermediate inputs or production equipment that may either not be available domestically, or available at higher quality or lower price abroad. Any reduction in production costs makes it possible for firms to lower their quality-adjusted output prices, thereby attracting higher demand and generating higher sales and profits.

Second, integration in global markets affects firms' output level and thus average costs if they produce or trade under economies of scale. On the one hand, access to

a bigger export market can bring about gains from economies of scale in production or exporting, i.e. under fixed production or trade costs. On the other hand, greater import penetration reduces domestic demand, and acts in reverse.

3.2 Globalization can also boost firm productivity and innovation

Globalization and global production sharing can also improve firms' incentives and capacity to improve their productivity by upgrading their production technology. This may entail innovating at the technology frontier, adopting a superior existing technology, or changing the set of production tasks and therefore the choice of production technology. While all three would benefit firm-level profits by revealed preference, the first would also advance the global knowledge base and could in principle generate spillovers to other firms and countries.

First, access to a great export market can encourage firms to incur any fixed or sunk costs of technological adoption and innovation. While import competition may reduce local demand, it can force incumbent firms to reassess if they are relatively more profitable with or without innovation in order to remain competitive.

Second, interacting with foreign buyers and suppliers permits active knowledge transfer and passive knowledge spillovers. On the production side, firms may gain production know-how and managerial competence. On the sales sides, firms may improve their expertise in product customization, marketing, and distribution. On the innovation side, firms may be empowered to step on the shoulders of giants and engage in follow-on innovation.

Third, participating in global value chains inherently means that firms reorganize the set of production tasks they retain in house and the set they outsource to input suppliers. This reorganization creates scope for efficiency gains, and brings about a reorganization of the firm's management structures, labor force in terms of occupational and skill composition, and potentially innovation capacity.

3.3 Seizing global growth opportunities requires strong firms, markets and institutions

Capitalizing on global growth opportunities requires three prerequisites: knowledge, capability, and incentives. First, in order to participating in global production networks or engage in innovation activity, firms need knowledge about global value chains and the technological frontier. Second, firms must have the right capabilities to successfully operate in GVCs or undertake research and development. And third, firms equipped with knowledge and capabilities must face the right cost-benefit incentives to profitably pursue GVC and innovation opportunities. In particular, the benefits of being a technological leader or more competitive on (quality-adjusted) price must outweigh the costs associated with R&D, technology upgrading, matching and transacting with foreign buyers and suppliers. These will in turn depend on a

range of policies governing market access, market structure, and investment in innovation.

These necessary conditions of knowledge, capability, and incentives can be mapped to firm, market, and institutional prerequisites. At the firm level, the key prerequisites are good technological know-how and effective management practices, which in turn contribute to production efficiency (the ability to produce at low cost) and quality capacity (the ability to produce at high quality). At the country or institutional level, firms require strong and stable institutions that guarantee contract enforcement and minimize uncertainty. At the market level, firms need efficient capital, labor and product markets to smoothly and effectively implement their optimal business plans.

Finally, less discussed but also critical for global supply chains is a well-functioning international market for the necessary supporting services. While global production networks generally span tangible goods such as manufacturing and commodities, their operation rests on intermediation services that lubricate the system, such as shipping, logistics, and financing. This points to synergies between the development of manufacturing and services sectors, and hence between any policies that affect them locally or multilaterally, for example through market regulation, industrial policy, or deep integration.

4 Production fragmentation improves firm performance given technology

Globalization, and global production networks in particular, can enhance firm performance holding firms' own productivity constant, even without them innovating or upgrading their production technology. Academic understanding of these forces comes from a large literature of theoretical and empirical papers.

I now embrace pointillism, and summarize the main messages emerging from my own research agenda to illustrate some of these forces. Each paper presents rigorous empirical evidence grounded in formal theoretical models, and some further provide quantification estimates from counterfactual analyses within the model. All papers exploit rich micro-level data across a range of countries in Europe, Asia, North and South America. They capitalize on the unique features of each economic environment to draw policy insights and obtain empirical identification.

The starting point is that participating in domestic or global production chains allows firms to keep their costs down and to upgrade their product quality, thereby improving their competitiveness, sales and profits.

For example, Manova & Zhang (2012) and Manova & Yu (2017) show that access to high-quality foreign inputs is key to export success in emerging economies, using comprehensive customs data for China for 2000-2006. Chinese firms that import inputs of higher quality from richer countries of origin are able to produce higher-quality products. This in turn generates higher export revenues, especially in rich destinations where consumers value quality more. Successful exporters also vary

product quality across markets and products in their portfolio in order to optimize export performance, by buying inputs of varying quality levels.

Bernard, Dhyne, Magerman, Manova & Moxnes (2022) establish that domestic production fragmentation likewise lowers firms' input costs and increases firm sales. We exploit detailed VAT data on the complete domestic buyer-supplier network for Belgium in 2002-2014. Larger firms transact greater values with more input suppliers and downstream buyers. Fixed matching costs induce a highly skewed distribution of network activity across firms, which amplifies the underlying firm productivity distribution, and explains the vast share of firm size dispersion.

What is required for firms to benefit from these performance gains from participating in global production networks?

4.1 Firm management practices matter

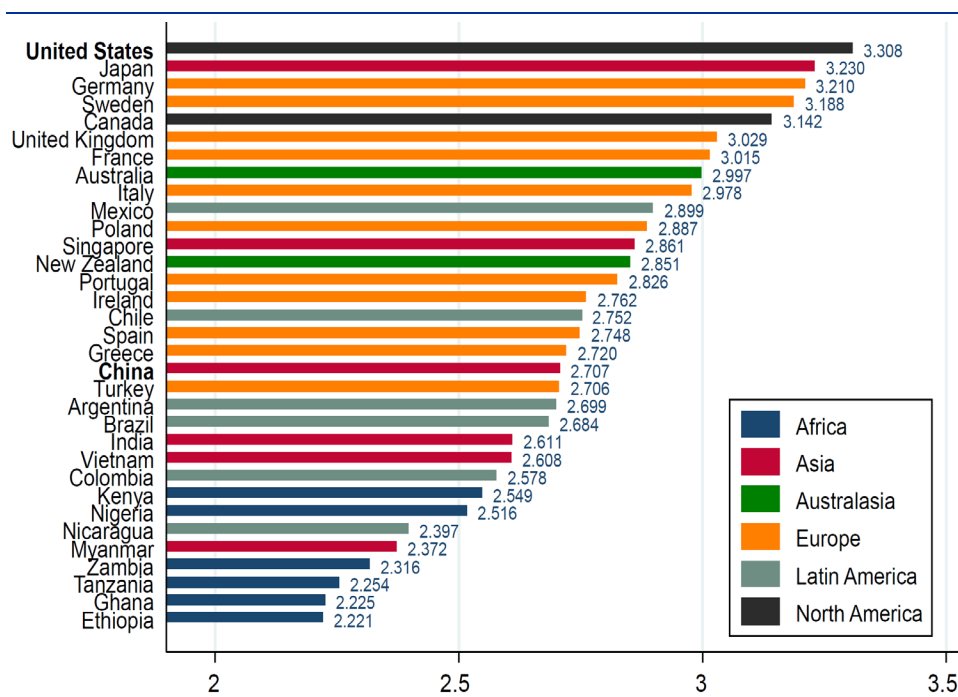
Firm management practices matter.

Firm productivity is often inferred as a black-box residual from a production function estimate that is sensitive to economic assumptions and econometric concerns. The World Management Survey provides the first direct, systematic measurement of a key tangible and actionable component of firm productivity: management competence. Management competence is based on an index across 18 practices for setting production targets, monitoring progress, and managing physical and human capital.

As Chart 2 illustrates, there is systematic variation in average management competence across countries. North America, Europe and Japan generally lead the pack, while Singapore and China outperform other countries in Asia, and Africa shows the greatest room for improvement. There is of course also significant heterogeneity in management scores across firms within countries.

Chart 2

Management practices across countries, World Management Surveys



Importantly, adopting super management practices can readily improve management outcomes and thereby firm performance. In contrast, it is less clear how firms or policy makers can raise a black-box notion of TFP. Indeed, a management consulting intervention in India resulted in treated firms implementing better management practices relative to non-treated firms (Bloom, Mahajan, McKenzie & Roberts 2020). Moreover, treated firms adopted better management organization not only in their treated plants that received consulting, but also in their non-treated plants. There were significant gains in their management scores long after the intervention, even 8 years on.

Bloom, Manova, Van Reenan, Sun & Yu (2021) show that better-managed firms are much more effective at global input sourcing, which is key to their successful export performance. We find consistent patterns in micro-level data for both China in 2006 and the United States in 2010, despite their very different levels of economic development, institutional design, and GVC position. Better-managed firms import higher-quality inputs and use more complex assembly technology in order to produce more sophisticated goods of higher quality. Moreover, they are able to produce these superior products more efficiently, at lower marginal cost. Both mechanisms grant them superior export outcomes.

4.2 Institutions matter

Institutions matter, both in terms of overall rule of law and in terms of institutions specific to capital, labor, and product markets.

Weak institutions and inefficient markets are known to introduce resource misallocation in an economy. Corruption and poor contract enforcement hinder general economic activity, while concrete market-specific frictions and regulations can also cause distortions to capital, labor, and product markets.

While it is well understood that a country with stronger institutions and more efficient markets will enjoy higher welfare than a country with more resource misallocation, the effects of policy reforms on aggregate welfare in a distorted economy are subtle and understudied.

For example, Berthou, Chung, Manova & Sandoz (2019) establish that both the sign and the magnitude of the gains from trade liberalization become theoretically ambiguous in the presence of resource misallocation. Intuitively, when countries operate in a world of the second best, trade reforms can bring greater welfare gains on the margin than in the absence of misallocation, if firms' response to the reform improves allocative efficiency. Conversely, trade reforms can result in lower welfare gains and even welfare losses if resource misallocation worsens. The outcome depends on the root cause of misallocation, and can in principle differ for import and export reforms. Moreover, welfare and aggregate productivity need not move together, further complicating policy implications.

Berthou, Chung, Manova & Sandoz (2019) also empirically explore the impact of export expansion and import competition on aggregate productivity in Europe, using data for 14 countries and 20 industries in 1998-2011. We document subtle patterns for general institutions (rule of law, control of corruption) and market-specific institutions (labor market flexibility, creditor rights' protection, product market regulation). As reported in Table 1, we find that efficient institutions, factor and product markets amplify the aggregate productivity gains from further import competition, but conversely dampen the marginal gains from further export expansion.

Table 1
Interaction effects of trade and institutions on aggregate productivity

Institution Measure:	In Agg Prod (ikt)				
	Rule of Law (1)	(Inverse) Corruption (2)	Labor Market Flexibility (3)	Creditor Rights Protection (4)	(Inverse) Product Market Regulation (5)
[^] Exp Dem (ikt)	1.066*** (0.126)	0.850*** (0.096)	1.121*** (0.261)	0.718*** (0.158)	1.314*** (0.172)
[^] Imp Comp (ikt)	-0.113** (0.050)	-0.063* (0.038)	-0.202** (0.096)	-0.108* (0.061)	-0.045 (0.061)
[^] Exp Dem (ikt) x Institution (it)	-0.476*** (0.067)	-0.302*** (0.042)	-0.218*** (0.069)	-0.048** (0.019)	-0.769*** (0.130)
[^] Imp Comp (ikt) x Institution (it)	0.136*** (0.031)	0.095*** (0.020)	0.083*** (0.027)	0.028*** (0.009)	0.085* (0.046)
N	2,777	2,777	2,777	2,777	2,777
R2	0.792	0.797	0.747	0.811	0.825
Ctry*Year FE, Controls	Y	Y	Y	Y	Y

4.3 Trade finance matters

Trade finance matters.

A large literature surveyed in Foley & Manova (2015) has established that well-functioning financial markets are critical to firms' ability to participate in international trade and investment. Stronger financial institutions such as creditor rights' protection support larger and more efficient financial markets, as manifested in higher levels of total credit to the private sector or stock market capitalization as a share of GDP.

Extensive evidence indicates that financial frictions severely impede international trade. These disruptive effects on trade far exceed any associated impact on production for the domestic market. Trade is also much more sensitive to the drying up of credit during episodes of financial crises such as the 2007-2008 global meltdown, even if it also bounces back faster (Chor & Manova 2012). Recent reports by the WTO and IFC have emphasized the persistent global trade finance gap.

Credit constraints limit firms' export entry and expansion in foreign markets, resulting in large distortions to aggregate export activity (Manova 2013). Financially constrained firms are also restricted to narrower, lower-value added and less profitable segments of global value chains (Manova & Yu 2016). These effects are concentrated on smaller, less productive firms and financially more sensitive sectors that require more external finance, have fewer collateralizable assets, and have less access to buyer-supplier trade credit.

Financial conditions have also been shown to importantly shape multinational activity. In particular, MNCs can only partially arbitrage cross-country differences in the cost of capital due to asymmetric information and contract enforcement across borders. Movements in host-country financial institutions or market outcomes thus influence MNCs' financing, entry, sales, and organizational decisions (Manova, Wei & Zhang 2015, Bilir, Chor & Manova 2019). Nevertheless, the affiliates of foreign multinationals are relatively less financially constrained than host-country firms that can tap only the local capital market. Foreign equity capital flows can thus partially compensate the impact of weak local financial development on aggregate exports (Manova 2008).

4.4 Trade finance insurance matters

Trade finance insurance matters.

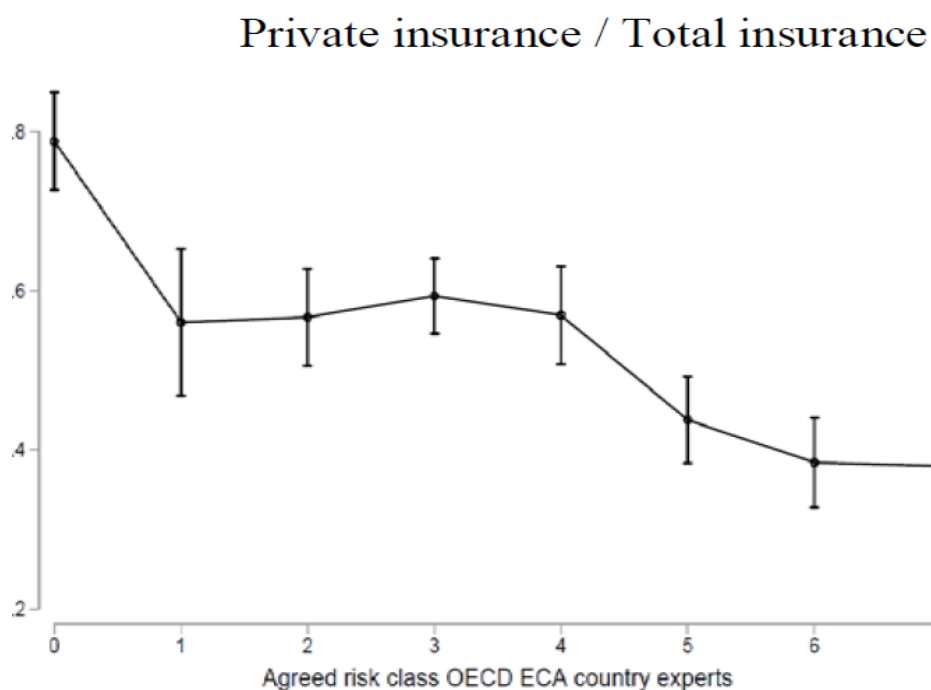
In ongoing work, Buus, Kroegeer, Manova & Munch (in progress) consider the role not only of trade finance, but also of trade finance insurance. Economic and political risk raises trade finance costs, and hinders trade activity as banks and other financiers request prohibitively high loan rates. Given the rise in supply chain, climate and geopolitical risks, trade finance insurance stands to become increasingly important.

We find that private and public export credit insurers are indeed instrumental in supporting trade with riskier markets. Micro-level data for EKF, the Danish public Export Credit Agency (ECA), reveals that only relatively productive firms are able to export to riskier destinations, and they do so using EKF insurance.

We also explore how public finance insurers complement private trade finance insurers in meeting firms' trade finance needs. The mandate of state-backed export credit agencies is to support transactions that the private sector is unable to cover, on the premise of a market failure. Cross-country aggregate data from the Berne Union reveals that ECAs indeed act as a valuable policy instrument: As Chart 3 illustrates, ECAs provide a greater share of export finance insurance for riskier destinations.

Chart 3

Composition of trade finance insurance by destination risk profile



Notes: Share of private export credit insurance in total export credit insurance across destinations by destination risk category. Authors' calculations based on Berne Union data.

4.5 Market competition matters

Market competition matters.

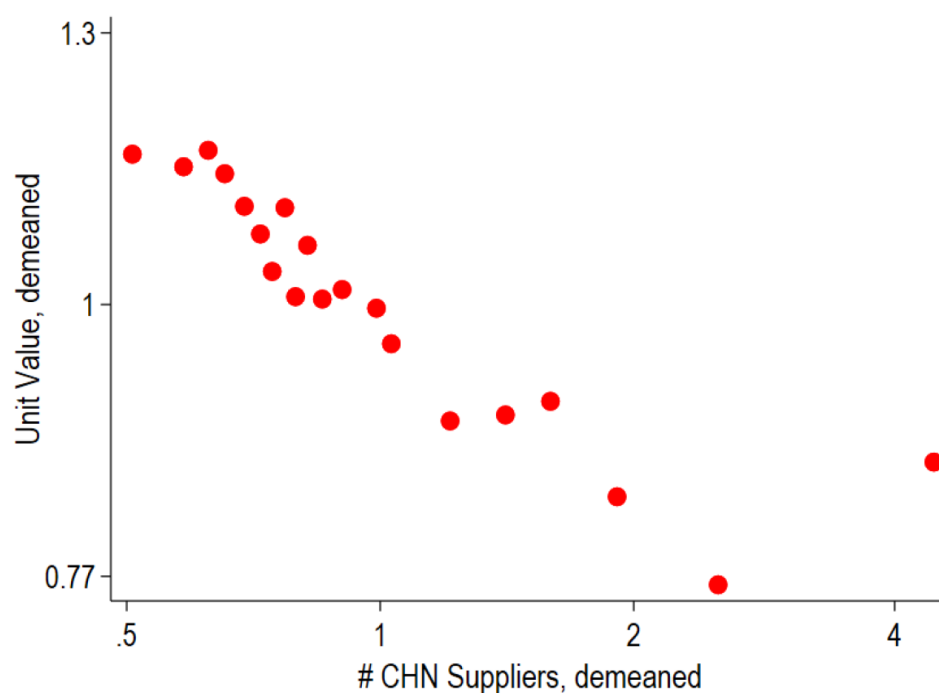
Given global interconnectedness, market structures in one country will shape firm performance in other countries through input-output production linkages. Behind-the-border interventions such as market regulation and industrial policy can thus have international spillover effects.

Huang, Manova, Perello & Pisch (2021) demonstrate that great market competition upstream indeed lowers input prices, improves downstream firm performance and profits, and raises consumer welfare. In the presence of matching costs, more productive downstream buyers benefit disproportionately more from entry upstream as they are able to add more suppliers, thereby inducing tougher competition among them and enjoying lower input mark-ups. In other words, suppliers price discriminate, and charge more diversified buyers lower mark-ups.

We look at how the dramatic rise in market entry in China after it joined the WTO in 2001 affected downstream buyers abroad. Transaction-level customs data confirms that French and Chilean firms import higher values and quantities at lower prices as upstream Chinese markets become more competitive over time, with stronger responses by larger firms. For example, Chart 4 illustrates that Chilean firms that source a given product from more Chinese suppliers pay a lower unit import price on average.

Chart 4

Import prices and number of Chinese suppliers across Chilean buyers



Notes: Average price paid on imported inputs from China by Chilean buyers depending on their number of Chinese suppliers. Chilean buyers have been binned into 20 bins, and import prices have been demeaned by product category. Authors' calculations based on Chilean customs data.

4.6 Market makers matter

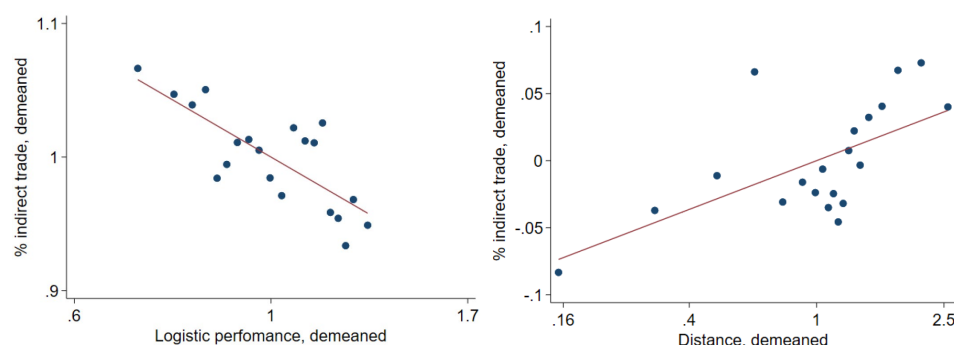
Market makers matter.

Firms face significant search, match and transaction costs when trading with their buyers and suppliers. Specialized intermediaries can help firms overcome these costs and benefit more from engaging with global production networks.

In ongoing work, Manova, Moxnes & Perello (in progress) examine the role of wholesalers in mediating international trade flows. We establish that trade intermediaries both widen and deepen production networks, by facilitating more buyer-supplier matches and by increasing sourcing intensity conditional on a match. This benefits especially productive upstream suppliers with low matching capability, and smaller, less productive downstream buyers, and brings about higher gains from international trade.

We provide consistent micro-level evidence for these patterns in customs transaction data for Chile. At the aggregate level, Chart 5 shows that wholesalers are especially valuable when firms face high trade costs: The share of intermediated imports rises quickly with bilateral distance to the origin country, and falls with its logistics infrastructure and efficiency.

Chart 5
Share of intermediated trade across origin countries



Notes: Share of Chilean imports intermediated by wholesalers across origin countries with varying logistics performance indicators and distance to Chile. Authors' calculations based on Chilean customs data.

5 Production fragmentation enables technology change within firms

Globalization can not only enhance firm performance given their own productivity when the right firm, market, and institutional prerequisites are in place. Globalization can also enable and induce firms to improve their productivity by adopting superior practices from the frontier, innovating at the frontier, or restructuring operations towards their core strengths.

The fragmentation of production across firms and countries inherently implies that firms choose to retain some tasks in-house and to outsource others to independent suppliers. This constitutes a technological change in that firms reorganize production practices and production resources, which presents opportunities for increasing their productivity. These dynamics can in principle differ between developed and developing countries that occupy different segments of global value chains. They may also present differently in the case of domestic and international outsourcing.

For example, Chor, Manova & Yu (2021) document a well-pronounced life cycle within Chinese firms over time using transaction-level customs data for 2010-2014. As firms grow bigger, more productive, and more experienced, they expand to span wider segments of the global value chain, adding more value in production, and reaping higher profits. In particular, firms gradually start importing inputs that are further upstream and exporting products that are further downstream, such that they are able to perform more of the intermediate production stages themselves.

In ongoing work, Bakker, Dyevre, Manova, Moxnes & De Paula (in progress) study how the domestic fragmentation of production across firms changes task complexity and the employment structure inside firms. We exploit comprehensive data on the domestic buyer-supplier production network matched to employer-employee records for the state of Sao Paulo in Brazil. We find that firms that outsource more tasks to domestic suppliers retain progressively more and more complex tasks in-house. This is associated with a shift in their employment composition towards more skilled workers and more managerial and technical occupations. Such reorganization may thus not only bring efficiency gains for the firm, but also influence the wage distribution in the economy.

6 Global innovators are becoming more globalized

6.1 MNCs lead innovation frontier and increasingly offshore R&D worldwide

Beyond redrawing firm boundaries, global production networks can also induce more innovation activity. This is a promising avenue for future research as these are less well chartered territories.

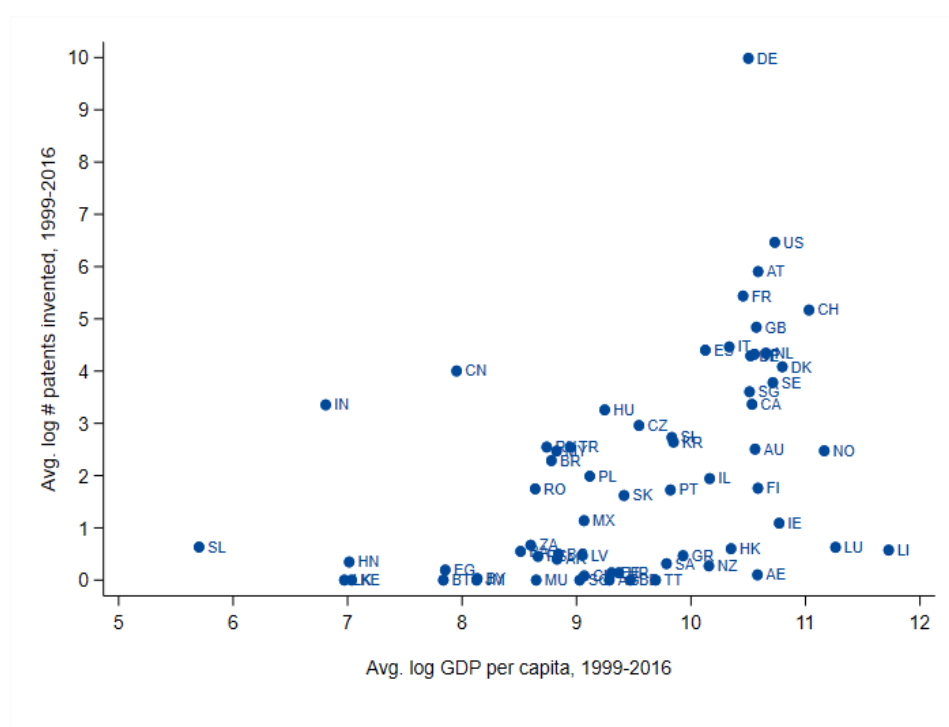
Today, multinational companies continue to conduct the vast majority of world R&D that pushes the knowledge frontier. They are also responsible for mediating knowledge transfer across borders. However, instead of innovating at their headquarters in traditionally developed countries in the global West as in the past, MNCs increasingly offshore research and development abroad. Moreover, they pursue R&D in both advanced and emerging economies.

This trend can be illustrated with the German auto industry. In 2017, Mercedes Benz opened an R&D lab in Seattle, primed to specialize in cloud computing. Soon thereafter, BMW unveiled an R&D center in Shanghai to focus on autonomous driving and automotive design. Both of these off-shore facilities perform cutting-edge research that can be deployed within the MNC operations worldwide.

In current work, Gumpert, Manova, Rujan & Schnitzer (in progress) examine the global production and innovation activities of German multinationals with matched micro-level data on the network of production affiliates and patents filed with the European Patent Office. We find that 30% of German MNCs hold EPO patents, and 43% of these innovative MNCs hold patents developed abroad.

As Chart 6 showcases, the top-5 hubs for foreign innovation by German multinationals are the USA, Austria, France, Switzerland, and the United Kingdom. Notably, China and India have made it in the top 15 in recent years. Moreover, German MNCs lead significant patent-generating activity in many countries across the spectrum of GDP per capita.

Chart 6
Patent innovation by German MNCs across countries

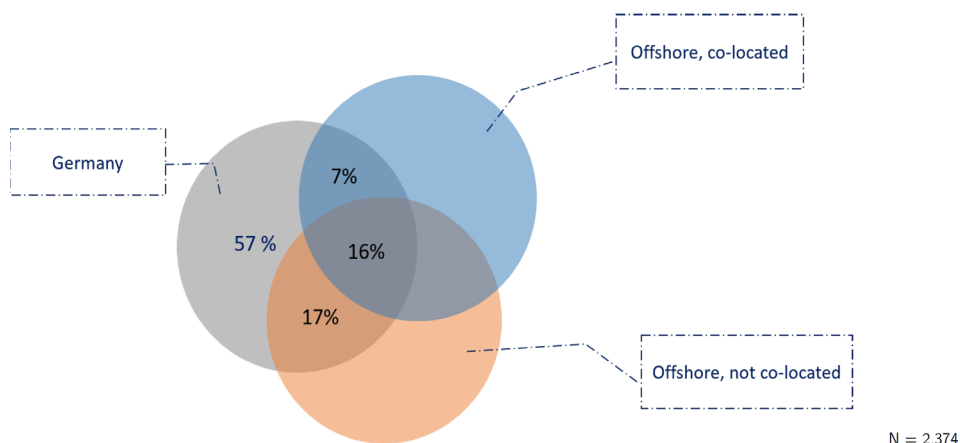


Notes: Number of patents invented by German multinational companies across countries. Authors' calculations based on German MiDi and PATSTAT data.

Using comprehensive information on all world patents invented in a given location, by any non-German firm, we also construct indicators of countries' revealed comparative advantage in innovation by technology class. For instance, Germany comes out with a comparative advantage in organic chemistry (e.g. pharmaceuticals), energy, and transportation; the US is strong in medical technology, IT, and telecommunications; while Switzerland leads in medical technology, precision instruments, and organic chemistry.

The Venn diagram in Figure 2 reveals that German MNCs that innovate abroad almost always also innovate at home. Moreover, they offshore R&D to countries where they maintain production operations (17%), to countries with no production affiliate (16%), or both (7%).

Figure 2
Breakdown of patenting German MNCs by innovation location



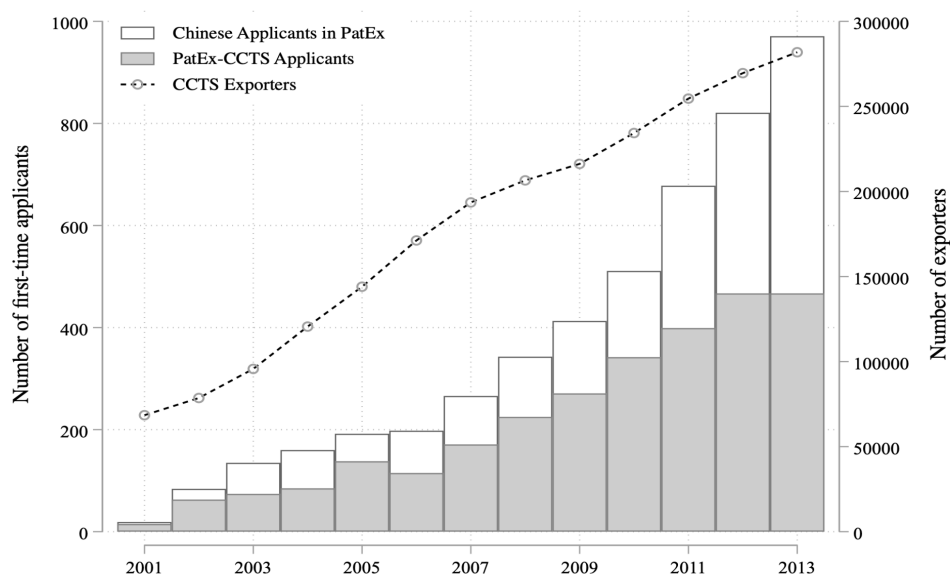
Notes: Venn diagram of where German multinational companies innovate their patents, distinguishing between innovation at home, in countries with a production affiliate, and in countries without a production affiliate. Authors' calculations based on German MiDi and PATSTAT data.

We also find that German multinationals offshore both basic and applied innovation, where applied innovation can be thought of as bringing immediate efficiency and profit gains, while basic innovation is a prerequisite for future successful innovation. The evidence suggests that applied innovation is disproportionately more likely to be collocated with production in developing countries with production wages are lower, compared to basic innovation that is more often performed in developed countries.

These patterns alleviate policy concerns that offshoring innovation activity may come at the expense of less innovation at home. Instead, our theoretical and empirical work points to complementarity in innovation across locations, as well as to cost synergies from co-locating production and applied innovation.

6.2 Emerging-economy pioneers increasingly innovate, but need global stamp of approval

Innovation today happens around the globe. Emerging economies are increasingly able to innovate at the frontier, as evidenced by the disproportionate rise of patent applications from developing countries filed with the US and European Patent Offices (USPTO and EPO) in recent years. For example, Chart 7 illustrates the dramatic growth in Chinese-invented patents submitted to USPTO after China joined the WTO and the global trade stage in 2001.

Chart 7**Chinese Trade and USPTO Patent Activity Over Time**

Notes: Number of Chinese exporters and number of Chinese applicants to USPTO over time. Authors' calculations based on USPTO US patent data and CCTS Chinese customs data.

Gong, Li, Manova & Sun (2022) analyze the impact of a first US patent award on the subsequent export performance of Chinese innovator firms. We find a 17% increase in worldwide exports, of which only a small part can be attributed to higher exports to the US of products related to the patent's technology class. Instead, most of this export boost occurs in third countries and for products unrelated to the patent.

Further analysis leads us to conclude that a US patent award expands Chinese firms' global sales by signaling their capacity to product at high quality and their credibility to honor contractual obligations. This is consistent with weak intellectual property rights (IPR) institutions in emerging economies not only deterring local innovation in the first place, but also limiting the extent to which firms can profitably monetize it in foreign markets.

7 Open questions

The world is more interconnected and more interdependent than ever before. We also face important global challenges as a world.

I close with two open questions that I view as focal as they are complex: the relationship between growth and growth+++ objectives; and holistic policy thinking given rapid technological change.

7.1 Growth and growth+++ objectives bring synergies and trade-offs

Policy making today is concerned not only with economic growth, but also with advancing what I would call growth+++ objectives. I think of inclusivity as pertaining to equality along multiple dimensions. I think of resilience as ensuring stable output and a steady growth path. And I think of sustainability as well-functioning institutions, social cohesion, and climate health.

What synergies and trade-offs do we face in advancing both growth and growth+++ objectives? What are the best platforms for decision making and policy design nationally and multilaterally?

7.2 Rapid technological change warrants holistic policy making

Policy making today also needs to confront rapid technological changes. I see the greatest promise in harnessing new technologies such as AI to enhance global growth opportunities and to alleviate barriers to seizing these opportunities. This requires designing institutions that support dynamic markets and innovation, and educating adaptable learners for life-long retraining.

How do we think holistically about joint trade, investment, and innovation policies? What are the best platforms for decision making and policy design nationally and multilaterally?

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