

Integrated Value Chain Risk Management

Agustina Calatayud
Juan Antonio Ketterer

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Agustina Calatayud
Juan Antonio Ketterer

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Contact: Gloria Lugo, glorial@iadb.org.

Abstract*

A widespread view in the private sector is that the lack of access to finance significantly limits the entry into and the performance of value chains. Access to finance is expensive, scarce, and short term in countries in Latin America and the Caribbean, and it hampers firms' investment and the financial management required to gain entry and remain as participants in a value chain. The lack of access to finance is a consequence of a series of market failures that form the basis for public policy intervention. The region's development banks and specialized agencies have thus designed programs to ease access to value chains and improve their performance. This paper suggests that the public sector could have a more effective role in enhancing value chain access and performance by embracing an integrated risk management approach to value chains. This approach will assist the public sector identify the various threats to which value chains are exposed, estimate the probability of occurrence and severity of such risks, and ensure risk prevention and mitigation through the use of a cost-effective combination of financial and nonfinancial instruments.

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Key words: finances, risk management, financial intermediaries, policies, productivity, value chain.

* Agustina Calatayud, Financial Markets Specialist, and Juan Antonio Ketterer, Division Chief, are in the Capital Markets and Financial Institutions Division of the Institutions for Development Sector at the Inter-American Development Bank.

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"To be prepared is half the victory."

Miguel de Cervantes Saavedra

Introduction

Greater participation in value chains and an improvement in their performance are essential for economic development. International evidence indicates that (i) firms that participate in value chains are more productive and (ii) countries that participate in value chains and in segments of higher added value demonstrate greater economic development. Enterprises in Latin American and Caribbean (LAC) countries, however, participate less than their peers in other regions and do so only in low added value sectors. The consensus in the private sector is that the lack of access to finance is the main factor behind this lag. Access to finance in LAC is expensive, scarce, and is only short term, making it difficult to invest in and practice the financial management that is necessary to access and remain as participants in a value chain. Restricted access to finance is a consequence of a series of market failures that forms the basis for public policy intervention. Development banks and specialized agencies in the region have designed programs to improve access and performance. This paper suggests that the public sector can have a more effective role in enhancing value chain access and performance by embracing an integrated risk management approach to value chains. This approach will help the public sector identify the various threats to which value chains are exposed, estimate the probability of occurrence and severity of such risks, and ensure risk prevention and mitigation actions through the use of a cost-effective combination of financial and nonfinancial instruments. In effect, access to a value chain and its optimal performance are conditioned by a series of risks—categorized as systemic, market, operational, credit, and liquidity risks—which are interconnected and affect the different actors in a chain. This means that when a setback occurs at a point within a chain—a specific node or link—it can affect the entire chain, thus reducing the expected effects of the individual risk management actions of each enterprise, as well as the public programs that aim to improve the access to value chains and their performance.

Currently, the development and adoption of an integrated value chain risk management strategy is limited by at least four factors. Firstly, the risks at a global level are not identified in order to mitigate them and implement the necessary preventive actions. Secondly, there is no coordination among private sector stakeholders within value chains, who tend to maximize local positions and pay little heed to global consequences. Thirdly, coordination between the private and public sectors is lacking, as well as among public agencies when identifying and implementing actions to remove value chain obstacles. Finally, there is a lack of access to finance which prevents the ability to implement actions to prevent and and mitigate value chain risks. These challenges require the proactive initiative of the various actors and sectors to collaborate in the design of a strategy that will enable the identification of risks, ways in which to mitigate them, and methods to leverage resources and competencies from one sector to the other to make the chain work more efficiently. Development banks and specialized public agencies can play a key role in developing risk management strategies and promoting access to finance so as to implement such strategies. The

Inter-American Development Bank (IDB) can be a key partner in this process by helping design specific programs and support the implementation of actions and necessary instruments.

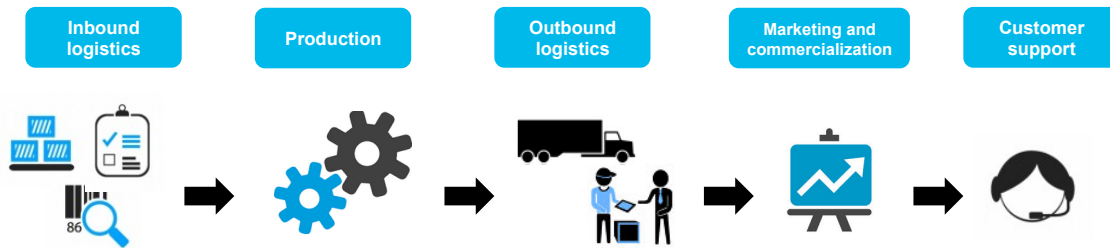
Section 1 of this paper explains the importance of value chains for the modern economy. Section 2 identifies the risks to which value chains are exposed and the consequences of their occurrence. Section 3 discusses the state of access to finance in the region as a significant cause of low participation by LAC enterprises in value chains. Section 4 addresses the role of public policy in improving access to finance and making risk management in LAC value chains more effective. Finally, Section 5 includes an appraisal of the role the IDB could play to support development banks and specialized public agencies in the design of integrated risk management programs for the region's value chains, so as to achieve greater impact of public policies and make more effective use of resources.¹

1. The Importance of Value Chains

Productive activities are organized in value chains. The value chain includes a combination of activities that range from the design of a product or service until its delivery or supply to the consumer. Among the main activities are the (i) inbound logistics relating to the appropriate inputs or services in terms of quality, quantity, price, time, and place; (ii) production to transform the inputs into final products; (iii) outbound logistics that include product storage and distribution to ensure the product is of the right quality, quantity, price, and is at the right place at the right time; (iv) marketing and commercialization that includes the drafting and execution of the goods and/or services sales strategy; and (v) customer support so that clients can seek information and technical assistance, lodge complaints, and negotiate returns and refunds, among other activities (Figure 1). Insofar as the progress of materials (inputs and final products) takes place through the different nodes of the chain, various functions and processes add value to them, thus achieving the highest added value at the least cost.

¹ This technical note is the first in a series of documents relating to value chain risk management. It outlines the theoretical and conceptual approach and provides examples and best international practices to illustrate its content. Forthcoming documents will focus on detailed analyses of practical cases relating to value chain risk management. The authors would like to thank Joan Prats, Ramón Guzmán, Raúl Novoa, and María Carmen Fernández for their valuable comments on the earlier versions.

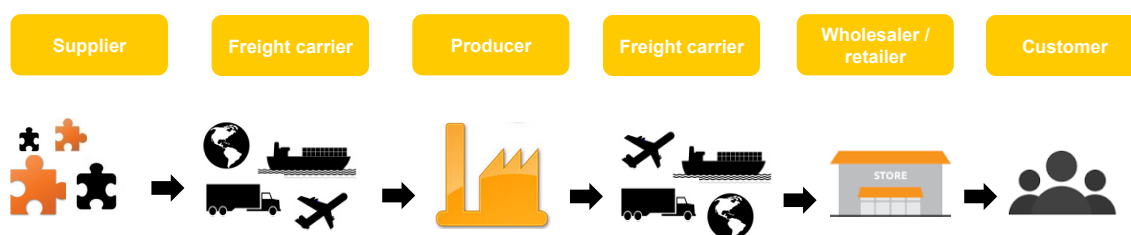
Figure 1. Main Activities in a Value Chain



The activities in a value chain are carried out by different actors. The main actors in a value chain are the suppliers of inputs and services, producers, freight carriers and logistic service providers, wholesale and retail distributors, and customers (Figure 2). In recent decades, the search for greater efficiency in productive processes has led businesses to employ different strategies in supply chain management.² On the one hand, there has been an increasing trend towards outsourcing the activities that can be performed more cost-effectively by specialized actors. This is true of activities such as logistics (especially transport and distribution) and customer support, which can be provided at lower operational cost, at higher levels of efficiency, and with greater flexibility by, for example, 3PLs (third-party logistics providers) in the former case and by call centers in the latter. On the other hand, progress has been made towards the vertical integration of key activities to add value and improve the competitive edge for businesses, such as research and development, by establishing specialized departments to encourage process innovation. There are also interconnecting actors in the chain that influence the development and performance of each one of its nodes. These include, for example, public and private sector institutions and agencies, as well as universities and research centers that, together with the regulatory framework, create the business climate within which value chains operate.

² Supply chain management is understood here to be the combination of techniques used to achieve the efficient integration of suppliers, producers, transport and logistics service providers, and distributors so as to ensure that products are produced in the right quantity, of acceptable quality, and are delivered on time to the right place, thereby minimizing costs and achieving the expected level of service (Simchi-Levi, Kaminski, and Simchi-Levi, 2003).

Figure 2. Main Actors in A Value Chain



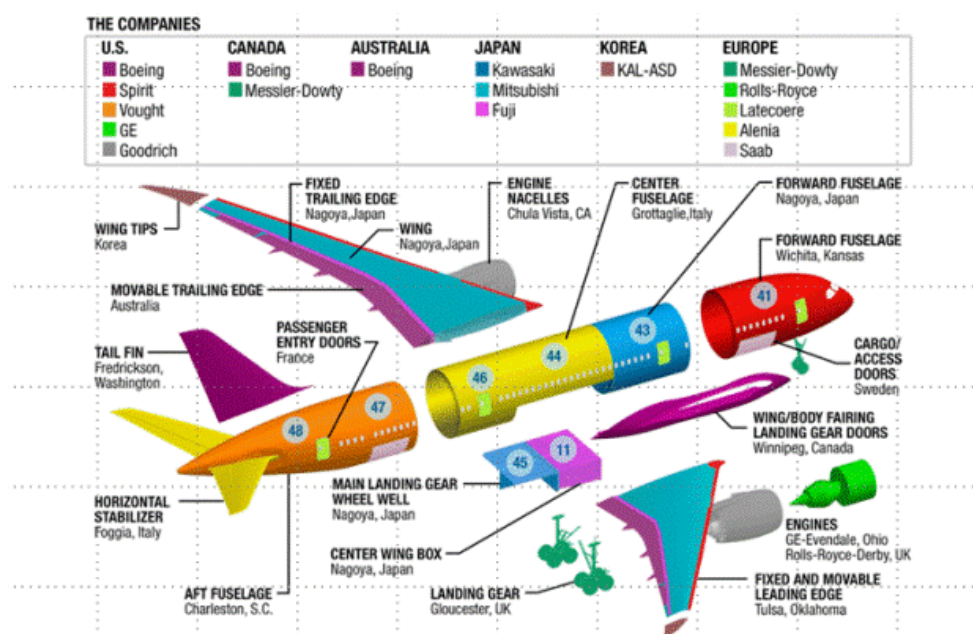
Value chains represent the paradigm of domestic and international trade in the twenty-first century. The integration of productive processes and actors in a value chain has been made possible as a result of a combination of factors, including (i) advances in operations and supply chain management techniques and technologies, in order to coordinate functions and processes, increase visibility throughout the chain, mitigate the risk of disruption, and minimize subsequent impacts; (ii) reduction of transport costs and greater logistics efficiency, enabling access to new markets for inputs and consumption, as well as the offshoring of activities at the domestic and international levels; and (iii) international trade liberalization and facilitation, contributing significantly to creating global value chains with actors located in different parts of the world and in search of greater operational efficiency at the lowest possible cost. The organization of trade into value chains takes place at both the domestic and the international levels. For example, Colombia's pharmaceutical value chain includes domestic and international suppliers and buyers, producers located in the central area of the country, and logistics nodes close to ports, airports, and the main urban centers (Figure 3). The Boeing 787 value chain, which is Boeing's biggest passenger plane in terms of size and capacity, is made up of 15 companies operating in eight countries and on four continents (Figure 4).

Figure 3. Production and Distribution of Pharmaceutical Products in Colombia: The Local Connection



Source: IDB (2012).

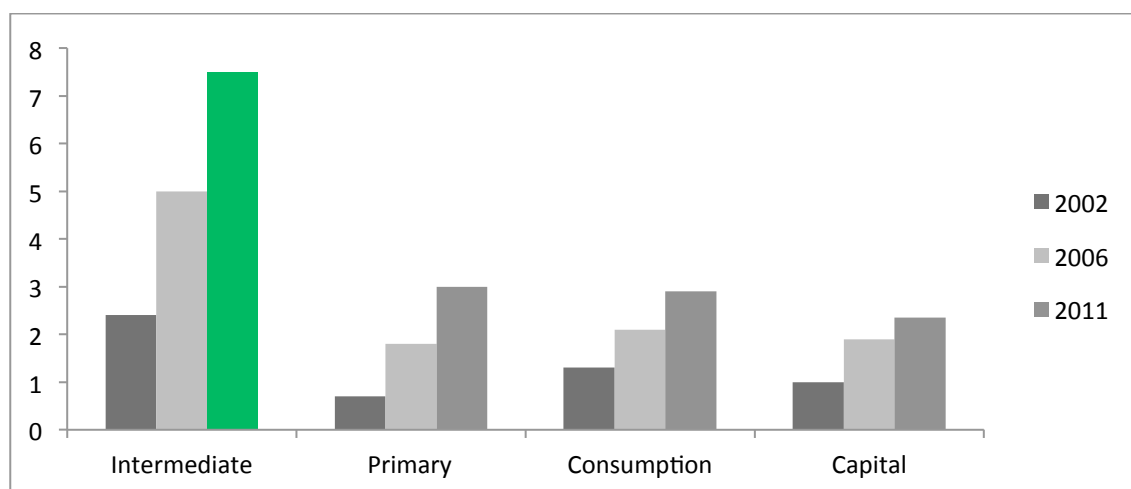
Figure 4. Building the Boeing 787: A Global Effort



Source: Boeing (2012).

Data at the international level bears witness to this paradigm shift. During the period 2002-11, international trade in intermediate goods was far higher than the trade in primary, final, and capital goods (Figure 5). Given that trade in intermediate goods specifically refers to the trade in the inputs used in final product assembly, the data relative to this stage of production can be used as a proxy for the presence of value chains at the international level. During the reference period, the trade in this type of goods was not only superior, but it also grew at a higher rate than trade in final and capital goods, which demonstrates the growing trend towards the establishment of global value chains, in consonance with the progress made in the same period in the areas mentioned in the previous paragraph (advances in operations and supply chain management techniques and technologies; reduction of transport costs and greater logistics efficiency; and international trade liberalization and facilitation).

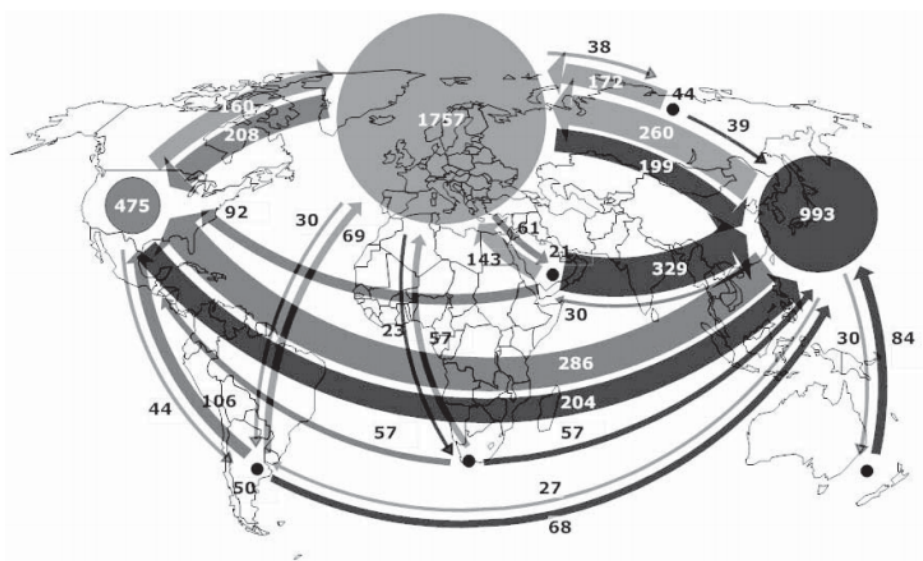
Figure 5. International Trade by Stage of Production (in billions of US dollars)



Source: UNCTAD (2013).

Participation in value chains, however, is lagging behind in certain regions, especially in LAC. It is worth highlighting the low participation in value chains in LAC compared to Asia or more advanced economies (Figure 6). In accordance with data from the Organisation for Economic Co-operation and Development (OECD) (OECD, 2013), whereas the trade in intermediate goods in the developed economies exceeded US\$4 billion, in LAC it hardly reached US\$500,000 million, including the trade flows in intermediate goods from the different sub-regions. In Asia, trade in this type of goods exceeded US\$2.5 billion. If the trade in intermediate goods is taken as a proxy for value chain participation, then LAC is clearly lagging behind.

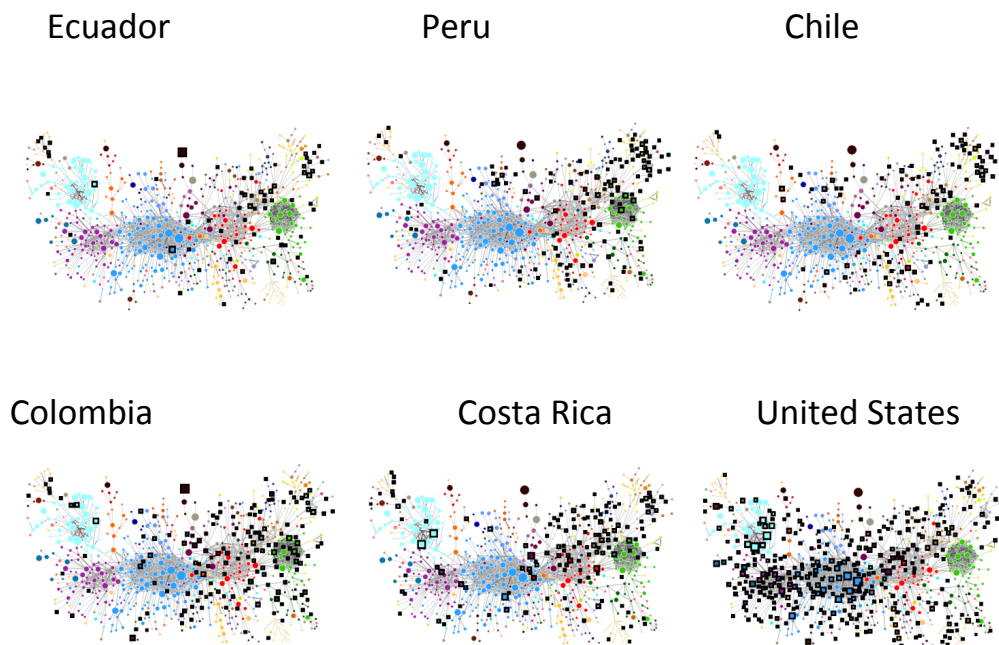
Figure 6. Trade in Intermediate Goods, 2011 (in billions of US dollars)



Source: OECD (2013).

In addition to this lack of progress, enterprises in LAC participate in the segments of the chains that add least value. A product-space analysis of the countries in the region reveals that LAC firms engage in providing goods that require low levels of product transformation and technification. This situation is especially serious in countries such as Chile, Ecuador, and Peru, which specialize in supplying commodities—oil, coffee, and copper, respectively—as well as other goods that require low production capacity and technology, placing these countries on the periphery of the product space. In contrast, firms in countries, such as Colombia and Costa Rica, manifest relatively greater specialization by supplying goods that require greater production capacities and technologies (e.g., pharmaceutical goods and computer components). These countries therefore have a relatively higher economic complexity with a slightly higher presence of more products in central areas of the product-space or close to them. The countries in the region, however, are a long way from having the complex product spaces seen in advanced economies, where the production and supply of goods requires sophisticated capacities and technologies that in turn enable them to add greater value to their products (Figure 7).

Figure 7. Product Space and Insertion in Value Chains (2011)



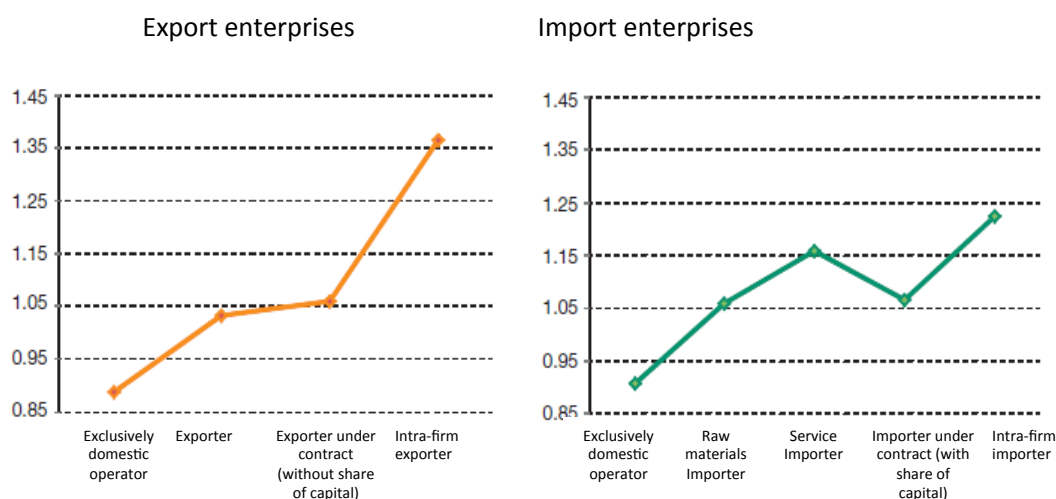
Source: Hausmann et al. (2013).

At the same time, value chains in the region face serious obstacles that hamper optimal performance. Among the challenges mentioned by studies based on private sector perceptions (OECD-OMC, 2013; FEM, 2013), access to finance, infrastructure and transport services capacity and availability, customs, sanitary and phytosanitary procedures, and the capacity for innovation are worth mentioning. Clearly, the effect that these factors have on the performance of the region's chains can vary according to the country and the specific chain. For example, transport or border delays most affect perishable goods. When combined, the aforementioned challenges generate greater operational costs and cause LAC enterprises to lose competitiveness.

Lower value chain participation or participation in lower added value stages—coupled with poor performance at the chain level—can be negative for productivity and economic growth. Recent studies reveal the relationship between participation by an enterprise in a global value chain (GVCS) and its level of productivity (UNCTAD, 2013). A productivity comparison of businesses participating in chains—whether exporters or importers—with those trading exclusively in the domestic market shows that the productivity of the former is approximately 60 percent superior (Figure 8). In turn, there is a positive correlation between higher participation by enterprises in GVCs and greater economic growth. A statistical analysis of the 1990-2010 period shows that, insofar as countries—developed and developing—increase their participation in GVCs, their economic growth rates also tend to rise (Figure 9). Although the available studies, so far, have not demonstrated a causal relationship, the data show that the 30 developing countries with the highest participation in GVCs recorded a per capita gross domestic product (GDP) rate of 3.3 percent, compared to the 0.7 percent posted by the 30 developing countries with lower participation (UNCTAD, 2013). Likewise, specialization in higher added value segments generates a

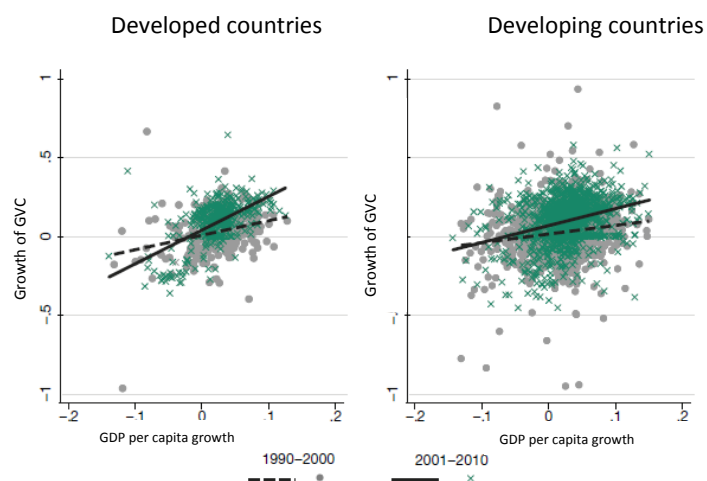
positive impact on economic growth. The available analyses show that an economy's different levels of complexity, with specialization in central or peripheral areas of the product space, help to explain the income inequalities between countries and can predict an economy's potential economic growth (Hausmann et al., 2013).

Figure 8. Productivity of Export Enterprises, according to Type of Enterprise, 2008



Source: UNCTAD (2013).

Figure 9. Increased Participation in Global Value Chains compared to Growth of Per Capita Gross Domestic Product



Source: UNCTAD (2013).

2. Complexity and Risks in a Value Chain

Modern industrial organization is characterized by a growing complexity. The trends that identify this organization, such as outsourcing, far sourcing, offshoring, just-in-time (JIT) production, consumer-driven production, and the flexibility to respond to demand volatility, have increased the complexity of value chain management and, consequently, the uncertainty and higher probability of risk occurrences. At the same time, new risks have also arisen, causing academics and practitioners to agree that value chains were not as exposed to risk as they now are since the end of WWII. On the one hand, this is a result of (i) the levels of interconnection and interdependence between enterprises that are greater than they were previously, and (ii) the fact that the competitiveness of a business no longer depends on itself, but on all the other firms with which it is connected within a value chain (Christopher and Holweg, 2011). On the other hand, the expansion of value chains at the international level generates greater complexity and makes them more susceptible to changing conditions in the business climate and demand, as well as in relation to the environmental and political situation in each country.

Access to a value chain and chain performance are conditioned by a series of risks. The presence of risk factors is an inherent element of value chain operation both for those organizations limited to the domestic market and for those that have an international dimension. Risk can be defined as the combination of the probability of occurrence of an event and its negative consequences (Holton, 2004). With particular reference to the value chain sphere, this could mean any risk that hampers the flow of information, materials, and products from the supplier to the final product user (Juttner, 2003). The specialized literature stresses that risk management, although only of recent interest in business and academic spheres, is becoming increasingly essential and challenging in terms of optimal value chain performance, especially in the context of greater uncertainties in supply and demand, the globalization of production, and the increasingly shorter life span of products and technology (Goldsby, 2009). Risk management can be defined as foreseeing and evaluating risks, and thereafter identifying the actions necessary to avoid them or minimize their impact. In effect, in the modern economy there is always a risk factor for value chain operation, either with regard to quality or security problems, supply restrictions or disruptions, climate conditions and natural disasters, regulatory or political uncertainty, or inadequate infrastructure, among others.

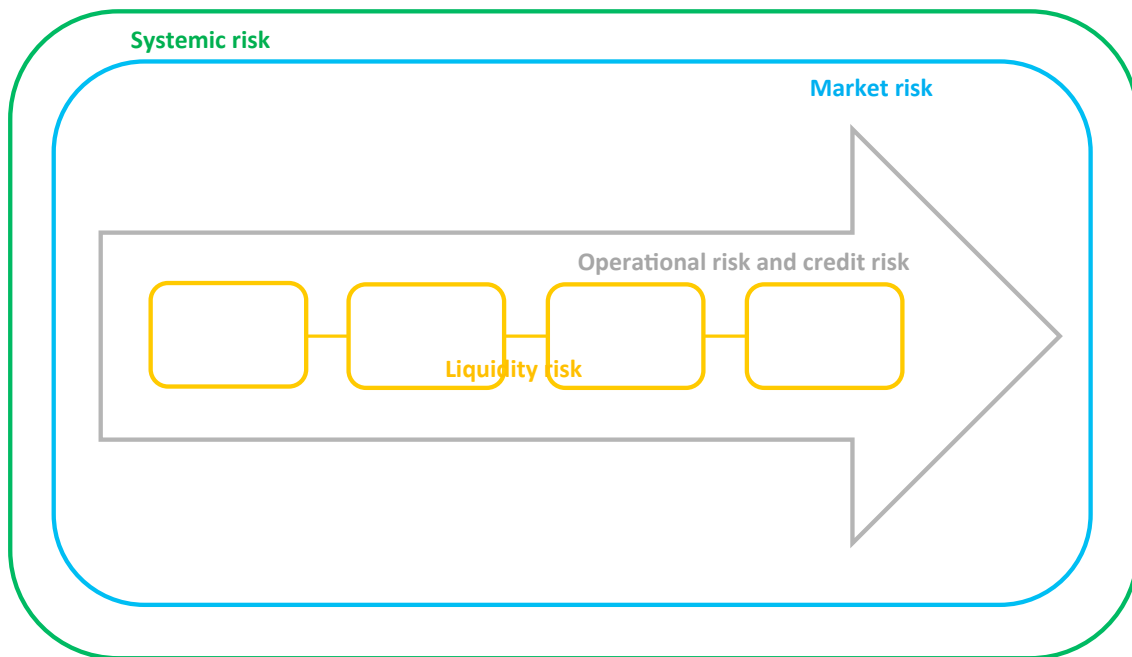
Despite the presence of risks, there are significant incentives for enterprises to participate in value chains. In a narrow sense, the incentive to participate in value chains might be explained by using a well-known strand of economic theory, according to which enterprises rationally choose to outsource stages of production when the costs of other enterprises doing certain processes—added to the transaction costs of coordinating such processes via the market—are inferior to the costs of carrying out such processes internally (Coase, 1937). Broadly speaking, the incentive to participate in value chains can be explained by a series of motives that are described in the specialized literature on industrial organization. Among these motives are the (i) enhancement of the market position through strategic alliances throughout the value chain; (ii) increase in competitiveness in the domestic and/or global market, which

creates alliances that lead to reduced costs and economies of scale, improved efficiency, strengthened superiority in certain segments of the market, or access to new segments; (iii) strengthening of product development and elaborate new products through alliances that encourage innovation; and (iv) diversification and reduction of risks, thus distributing them among more than one actor (Dess et al., 2010).

The presence of risks, however, can influence the cost-benefit valuation of an enterprise with regard to its possible participation in a value chain. In a value chain, efficiency depends on every activity, process, and function throughout the chain being performed efficiently (Porter, 1998). The complexity of the activities, processes, and functions involved in a productive process, together with the multiplicity of actors participating in a value chain, can be the source of different risks that, according to their probability of occurrence, may discourage participation by an actor in a value chain. Since modern production and trade organization is conducted through value chains, and since businesses no longer compete alone in their markets but, rather, as part of their chains (Brewer and Speh, 2000), value chain risk management becomes of critical importance for the modern economy. In the past, enterprises focused on the risks that they might face at an individual level in order to optimize their own operations. Today, they must widen this perspective to include the risks that emerge from the complex network of interactions between suppliers and clients. Therefore, elements such as collaboration, visibility, and integrated management are key tools for reducing costs and maximizing an enterprise's profits and competitiveness in a given market.

The risk that affects value chain performance can be categorized as (i) systemic, (ii) market, (iii) operational, (iv) credit or (v) liquidity risks. In the specialized literature, there are different ways to classify risk. This paper classifies risks into these five categories, described in detail below. Generally speaking, these categories can be distinguished according to the level in which the risk arises and where the consequences become evident. While systemic risks can emerge at the global level, independent of a particular industry or chain and affecting all industries and chains, market risks can affect a sector of economic activity. Operational and credit risks are manifested at the local level in the nodes of a chain or in the relationship between them. Finally, liquidity risks emerge at the level of a specific node or actor in a chain (Figure 10).

Figure 10. Categories of Risk in Value Chains



Systemic risks are those which affect the operation of the economy in general.

The sources of these risks may be political, macroeconomic, social, or environmental uncertainties. Political uncertainties, for example, may include situations of political instability, change in government policy, war, terrorism, piracy, or military coups. Macroeconomic uncertainties refer to fluctuations in the levels of economic activity or relative prices that affect the normal pursuance of economic activities. Uncertainties of a social nature are related to changes in peoples' beliefs, values, or attitudes, which may or may not be reflected in government policy or business practice (Goldsby, 2009). Natural uncertainties include phenomena such as floods, droughts, earthquakes or hurricanes, among others. Although the magnitude in which systemic risk impacts on the chains or the sectors of a country's economy may differ, the common feature is that all these will be affected in one way or another by such risks. Among the effects of this risk category are partial or total disruption of value chains, which seriously affects stability and the very existence of such chains. The challenge that this type of risk presents for value chain operation is increasingly greater in the context of the globalization of production and of the emergence of global value chains, as well as in the face of the influence of global warming on increasing the magnitude and probability of occurrence of natural disasters.

Market risks affect the operation of a specific sector of the economy. These risks include, among others, fluctuations in the levels of domestic and international prices for inputs and products, input availability, technological change, change in consumer preferences, availability of substitute products, and quality standards in the sector. Market risks can affect value chain stability in the reference segment, whether due to a transformation in the conditions for accessing inputs or due to a shift in the conditions of demand. For example, rising oil prices between 2006 and 2008 significantly increased the cost of supply chains intensive in the use of fossil fuel, such as the transportation and energy supply chains. Technological change in the electronic and

telecommunications industries, following the invention of MP3 players in the former case and mobile cell phones in the latter, altered customer preferences and reduced consumer demand for Discmans and pagers, respectively.

Operational risks are those which affect the operation of a specific value chain, and which may arise at the level of a certain node or in the relationship between two or more nodes. This type of risk affects information or product flows throughout a chain. Among the sources of this type of risk are disruptions to production due to mechanical, technical, or process failures; forecasting errors in input acquisition and in demand forecasting; failures in the power, communications, and transport infrastructures; disruptions in the chain due to delays or failures in administrative procedures; disruptions in the chain due to failures in the quantity and/or quality of products provided by suppliers; and failures in the quantity and/or quality of the products delivered to the consumer. An example of the effects of this type of risk cited in the specialized literature is the case of Toyota which, in 1997, was forced to close 18 plants for two weeks due to a production failure at its main brake valve supplier (Ritchie and Brindley, 2004). At the same time, in countries where electrical power supply is patchy, enterprises often complain that this factor has the biggest impact on their cost structure and poses the greatest risk of chain disruption. Similarly, complex and time-consuming customs clearance and transit processes, as well as sanitary and phytosanitary certification are mentioned in practically all the surveys of the challenges posed to participation in international trade, given that they add to logistics costs and increase the uncertainty and variability of the lead time in a chain.

Credit and liquidity risks affect the financial stability of a chain or its nodes. Credit risks refer to problems arising from collecting payments from clients. The default of such payments can seriously affect the liquidity flow of a business, while at the same time jeopardize payments to input and service suppliers, thereby generating a cycle of defaults that is difficult to resolve (Kleindorfer and Saad, 2005). Factors such as uncertainty regarding collateral, reputation, a specific business segment—as in the case of small- and medium-sized enterprises (SMEs), in which there are generally more information asymmetries and informality—or a certain sector (e.g., the agriculture sector which also has greater information asymmetries and informality than in other sectors) increase credit risk. Liquidity risk is related to the problems that an enterprise might face when trying to meet its short-term obligations. Factors such as long payment cycles, the financial health of an enterprise, and restricted access to credit influence the probability of occurrence of this risk. Since the actors that participate in a value chain do not all possess the same degree of financial stability, liquidity problems for one or more actors can have consequences for the financial stability of the entire chain.

Table 1. Risks in Value Chains

Type of risk	Impact	Sources	Example
Systemic	On the general economy	Political uncertainties	Situations of political instability, changes in government policy, wars, terrorism, coups d'état, piracy.
		Macroeconomic uncertainties	Fluctuations in levels of economic activity, or relative prices.
		Social uncertainties	Changes in peoples' values, attitudes, or beliefs.
		Environmental uncertainties	Floods, droughts, earthquakes, hurricanes.
Market	On a specific sector of the economy	Market uncertainties	Fluctuations in price levels of inputs and products, input availability, technological changes, changes in consumer preferences, availability of alternative products.
		Regulatory or institutional uncertainties	Quality standards and regulations, changes in the specific regulations of the sector.
Operational	On a specific value chain	Supply uncertainties	Delays in deliveries, failures in input quantity or quality.
		Production uncertainties	Mechanical, technical or process failures, forecasting errors, infrastructure failures, failures in product quantity or quality
		Administrative uncertainties	Failures or delays in administrative procedures, such as importation and exportation, compliance with quality standards.
Credit	On a specific value chain or its nodes	Collateral uncertainties	Quality and value of collateral.
		Uncertainty about the sector	Sectors in which there is greater information asymmetry, such as agriculture and the new technologies.
		Uncertainty about the segment	Small and medium enterprises, in which there is greater information asymmetry and informality.
Liquidity	On a specific enterprise	Uncertainty about the payment cycle	Non-compliance or extensions in the payment cycles that can cause delays in the firm's short-term commitments. .
		Uncertainty about the firm's financial health	Incomplete or out-of-date financial and accounting records, with low information quality. .

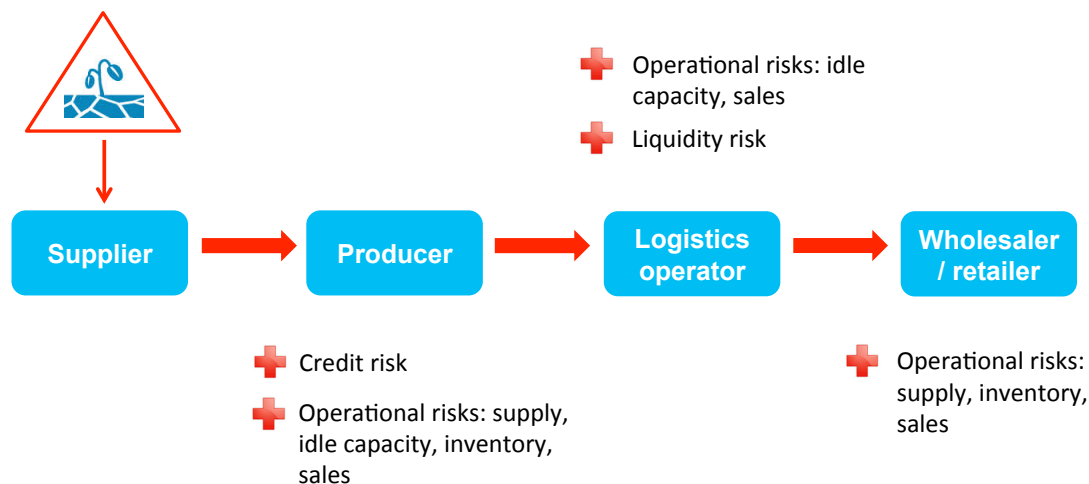
Source: Authors' elaboration.

Various international studies indicate the importance that the different risk factors have for business and value chain operation and sustainability. Insofar as enterprises advance towards “leaner” supply chains, decentralized production processes, and outsourced processes, risk management becomes a critical factor for value chain stability and even survival. Practitioners highlight supply failure, natural disaster, political and regulatory uncertainty, failure in logistical processes, damage to product quality, and delay in customs procedures among the most serious risk factors faced by a value chain (Hillman and Keltz, 2007; UPS, 2014). Due to the negative impact that these risks can have in a value chain, some international surveys show that businesses now pay more attention to risk management with regard to their supply chains. According to the survey conducted by Deloitte (2015) of 600 large enterprises in the international sphere, 71 percent considered risk management as an important aspect in decision making and 64 percent acknowledged that they had a specific risk management strategy for their supply chain.

In most cases, the materialization of a risk (an incident) entails a higher probability of various risks occurring throughout the value chain. In other words, the risks might be interconnected. For example, in the case of an agro-industrial chain, adverse climactic factors, such as a drought that affects the supplier, can increase the producer's credit risk if the latter has financed the former, and they can also drive up

operational risk due to the restricted availability of inputs or of poor-quality inputs. Logistics operators could be affected by lower demand for their services, thus leading to higher idle capacity and lower sales, which can also increase their liquidity risk. Finally, wholesalers and retailers could be affected by a fall in the supply of goods, the need to increase their inventories, and lower sales that are caused by scarcity (Figure 11). Given that the effects of a risk in a chain are rarely contained in the node or link in which it occurs, it becomes crucial for the chain's stability and optimal performance to develop risk management strategies that identify the risks to which the chain is exposed, the probabilities of their occurrence, and the effects that they might have at the global level. At the same time, due to the interconnection of risks within a chain, it is important that all actors adopt (or participate in) risk management strategies. Free riding behaviors—in other words, actors seeking to benefit from the risk management strategies of its partners in the chain without having to participate or implement their own strategies—can lead to suboptimal equilibria, wherein the occurrence of incidents that affect the free rider will result in the misfortunes of other nodes.

Figure 11. Risks in the Value Chain



Lessons learned from international experiences reveal the impact that a risk can have on value chain participants. This section presents various examples of the impact that different types of risks could have. These relate to systemic risk, such as the 9/11 attacks on the United States, the earthquake in Japan in March 2011, the floods in Central America in 2008, and the strike by port workers on the west coast of the United States in 2011. In 2001, the 9/11 terrorist attacks deepened the economic recession in the United States, which particularly affected the technology and telecommunications sectors. CISCO, for example, lost US\$2,500 million in terms of inventory in the wake of this catastrophic event. The earthquake of 8.9 degrees on the Richter scale that hit Japan in 2011 had consequences that spread out on a global level, given that hundreds of companies—among them Boeing, Honda, and General Motors—whose suppliers were located in Japan, were forced to reduce their production levels drastically (e.g., General Motors' production at its United States plants fell by half) and they experienced massive disruptions, which were felt up to the end of that year, causing losses estimated at US\$240,000 million. In 2008, the floods that affected banana producers in Costa Rica and Panama caused losses throughout the entire

chain. Among them, Chiquita reported losses of US\$33 million in terms of land restoration, logistics costs, and inability to attract new suppliers. In 2011, labor disputes that led to the closure of the ports on the west coast of the United States for almost two weeks interrupted normal value chain operation and generated costs for the country's economy of approximately US\$19 billion. With regard to operational risk, examples are numerous and only three of the most illustrative cases are mentioned. In 1997, to save US\$0.75 per unit, Whirlpool outsourced the production of the water seal of its dishwashers. This represented a yearly saving of US\$2 million. The supplier, however, unexpectedly changed its own rubber provider. The new rubber leaked water in dry climates, causing a 10 percent failure rate. By the time Whirlpool had discovered the issue, more than two million dishwashers had been manufactured with two months' worth of inventory in transit. This quality failure cost the company millions of dollars, far above the saving generated by the initial outsourcing. Another case occurred in March 2000 when a lightning strike caused a power surge in the electrical network of Albuquerque, New Mexico, causing a fire at one of Philips' microchip plants. The plant supplied Ericsson which, at the time, applied an exclusive supplier policy. The blaze caused a disruption to Ericsson's production for months, resulting in a sales loss of US\$400 million. Finally, in 2007, Mattel was forced to recall 19 million toys from the market because suppliers had used paint containing lead during production—a potential health hazard to consumers.

Owing to these impacts and to the growing value chain complexity, enterprises and the specialized literature on supply chain management have begun to place more importance on risk management. The greatest complexity is apparent at various levels; that is, (i) network complexity caused by the increase of actors in the chain and the links between them; (ii) process complexity due to the increased number of processes; (iii) product complexity owing to the higher number of components; (iv) demand complexity due to increased demand volatility and fragmentation; and (v) organizational complexity due to the increased number of levels involved and their tendency to work in silos (Christopher and Holweg, 2011). This means that the most suitable level at which to develop a risk management strategy is no longer at the enterprise level; rather, it is at the value chain level, evaluating and addressing the risks in an integrated manner throughout the chain.

Various early warning systems have been developed and implemented to identify possible problems, evaluating their severity and issuing warnings of potential impacts. These systems continuously analyze information produced by the different processes and actors in a value chain. The data is compared to previously established indicators and objectives, based upon which future situations are predicted. Whenever the current situation is seen to be below the established indicators and objectives, a warning is issued. Based on information provided by these systems, enterprises have at their disposal the measures to manage any given risk situation. Early detection of risk situations gives enterprises a wider margin in terms of time and ability to maneuver so as to avoid or, at least, minimize disruptions in the chain (Genc, Duffie, and Reinhart, 2014). For example, a system that warned BMW about the financial problems faced by one of its key suppliers enabled BMW to avoid disruption to the manufacture of its Z4 convertible. Given that locating an alternative supplier would have meant a delay in deliveries of at least six months, BMW offered financial support to the supplier

so that it could continue its operations. Mercedes-Benz, another automobile company, has also set up an early warning system that gathers information from its suppliers and includes data on idle capacity and inventory levels.

Risk management strategies at the value chain level, however, remain scarce.

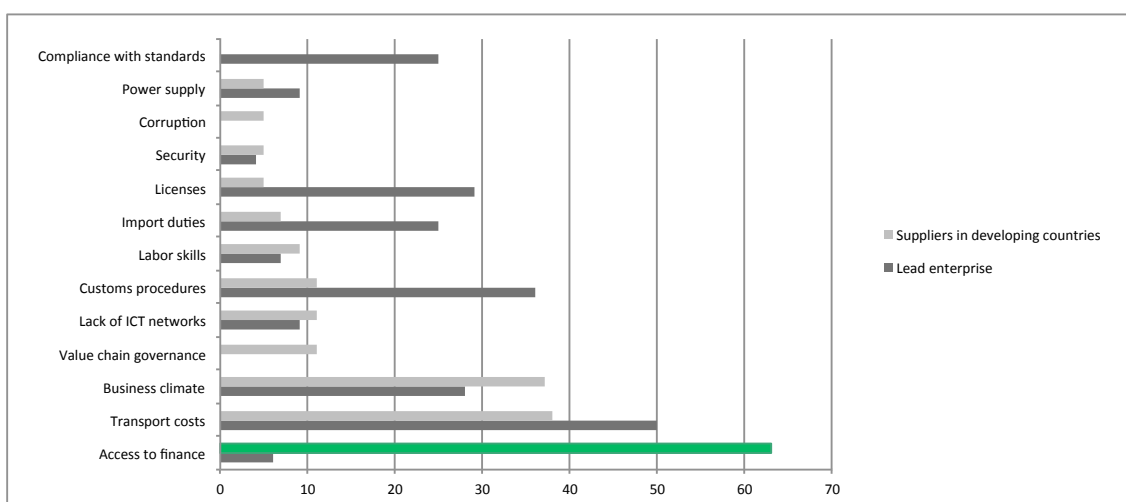
Although international surveys indicate that large enterprises are conscious and, in many cases, have risk management strategies for their own supply chains, these strategies are implemented at the individual business level and in few cases involve partners. Likewise, risk management strategies are practically absent in SMEs. However, given that (i) such enterprises tend to be suppliers or clients of large enterprises and (ii) processes, sources of value and competitiveness, and information are spread across the chain, it is crucial to design integrated risk management strategies that include all actors. Nevertheless, there are two problems with regard to value chain risk management. First, strategies are scarce and, second, even when they are designed and implemented, this only happens at the individual enterprise level. Risk management at the global chain level is critical for the future of value chains, a fact that the specialized literature stresses, although in practice it has yet to be completely implemented (i.e., the search for greater value chain integration). In the current context, building collaborative links between all actors in the chain and integrating processes, information systems, and business strategies are as important as—or even more important than—the internal optimization of processes at the firm level (Christopher and Holweg, 2011). This is significant, since greater integration will enable a better risk diagnostic, a faster reaction to change, an enhanced process optimization, and a more effective use of company assets.

3. Risk Management and Access to Finance in Latin America and the Caribbean

Designing a suitable risk management strategy is essential for optimal value chain performance. This strategy must identify the potential sources of risk and the appropriate actions to either prevent or reduce the impact of an incident on a value chain. The greater the awareness of the risks to which the value chain is exposed and of the potential impacts, the better the capacity to identify and prioritize the actions to manage the risks, thereby leading to greater chain resilience, sustainability, and profitability. Due to the interdependence of the nodes in a chain, an adequate risk management strategy should be designed to prevent risk and reduce chain vulnerability as a whole. In other words, optimization should be sought at the global level rather than at the local or individual enterprise level. Therefore, any analysis should take into account the obstacles and risks present at each level of the chain, as well as their respective causes, the probability of occurrence, the severity of impact, and the actions recommended to prevent or mitigate them. As previously mentioned, however, it is evident that risk management strategies are rarely adopted (compared to the existing number of enterprises), usually focus on a single enterprise, and rarely count on other partners in the chain.

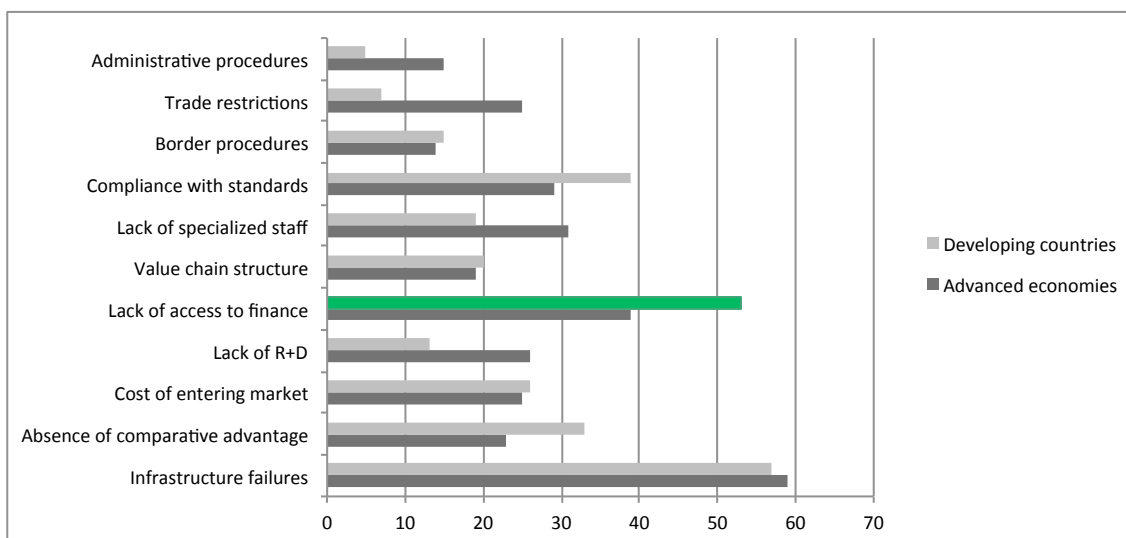
Access to finance is an indispensable factor in the implementation of a risk management strategy. Risk prevention and mitigation generally require financial resources and instruments to enable investments in physical capital, technology, processes, and human capital formation to finance procurement, ensure adequate liquidity levels, and cover damages or losses in the event of an incident, among others. For example, potential changes in the quality standards of an industry or the lead firm, in the demand, or in social values or attitudes usually require financial resources in order to adopt technologies, modernize productive processes, and adapt to new technical and/or phytosanitary requirements. Potential failures in transport and telecommunications infrastructures, as well as the delay of or default in payments by clients may require liquidity to cover the losses caused by disruptions to material, information, or financial flows. Since appropriate risk management aims to reduce chain vulnerability at the global level, it is essential that resources and financial instruments be available at all levels in the chain. In effect, due to the previously mentioned interconnection of risks, implementing risk prevention and management actions by one or some of the actors with the greatest access to finance will only lead to a suboptimal solution, since risk management requires action throughout the entire chain. The recent study conducted by the OECD and the World Trade Organization (WTO) in 80 countries reveals that the lack of access to finance is viewed by the private sector in developing countries as the most serious obstacle to being able to participate in value chains—beyond the cost of transport and customs procedures—(Figure 12), and it is second in importance in relation to the public sector in these countries, immediately following infrastructure (Figure 13). In addition to access to finance, the study demonstrates the importance of other factors, such as transport costs and capacity, business climate characteristics, governance in the value chain, use of information and communication technologies (ICT), and customs procedures—all of which limit the participation of enterprises in value chains. Given its significance, and in line with this paper, the following analysis will focus on access to finance.

Figure 12. Barriers to Participation in Value Chains (Private Sector)



Source: OECD-OMC (2013).

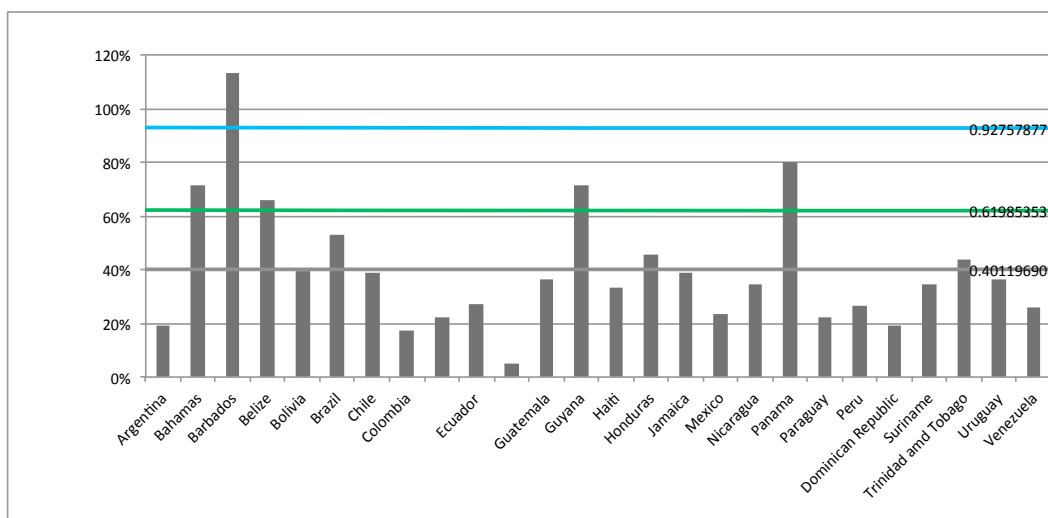
Figure 13. Barriers to Value Chain Participation (Public Sector)



Source: OECD-OMC (2013).

The lack of private sector access to finance in LAC constitutes the weakest link in improving performance in the region's value chains. In LAC countries, there is insufficient access to finance for the productive sector. The banking system's capacity to efficiently channel funding for productive activities is an essential element for the operation of the economy. In LAC, bank finance for the private sector has hardly risen by 1 percent since the 1980s, representing an average of 41 percent of GDP for the period 2007–11. This value is significantly below the rate achieved in OECD countries (131 percent) and by other emerging economies (68 percent) (Figure 14). At the same time, the relative importance of bank credit to businesses in the overall portfolio has decreased from 66 percent to 60 percent between the years 2000 and 2010 (de la Torre et al., 2012).

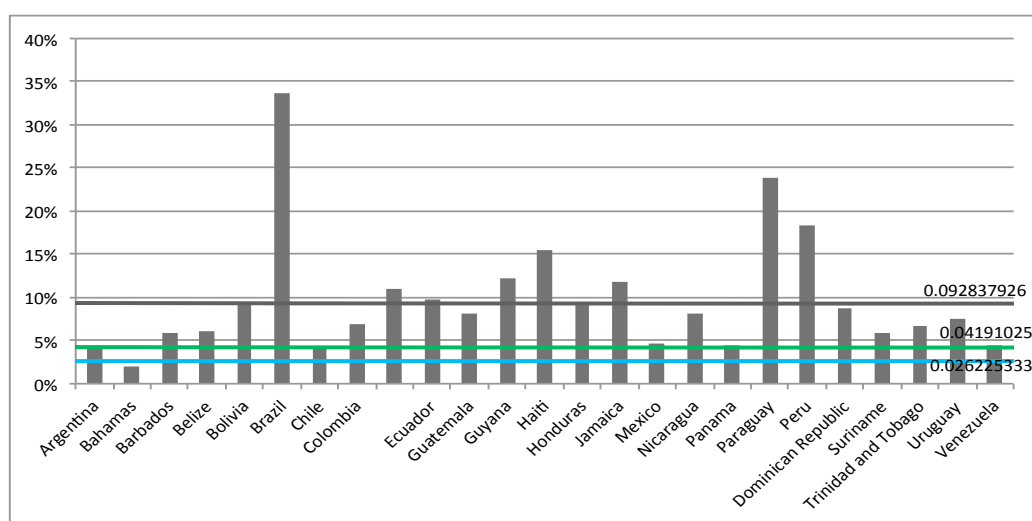
Figure 14. Credit to the Private Sector as a Percentage of Gross Domestic Product, 2007–11



Source: Authors' elaboration based on World Bank (2014).

As well as being scarce, productive sector financing in LAC countries has the highest banking intermediation margins compared to other groups of countries. During the 2007–11 period, the average net banking intermediation margin in LAC countries was 9.28 percent, more than double the rate of other emerging economies (4.19 percent) and nearly four times higher than that of OECD countries (2.62 percent) (Figure 15).

Figure 15. Net Banking Intermediation Margins in Latin America and the Caribbean, 2007–11 (as a percentage)



Source: Authors' elaboration based on World Bank (2014).

Poor banking intermediation in LAC countries has negative consequences for productive sector financing and value chains. In LAC, only 36 percent of enterprises use credit for working capital compared to 38 percent in Asia and 48 percent in Europe. Only 20 percent of enterprises in the region use credit as a means

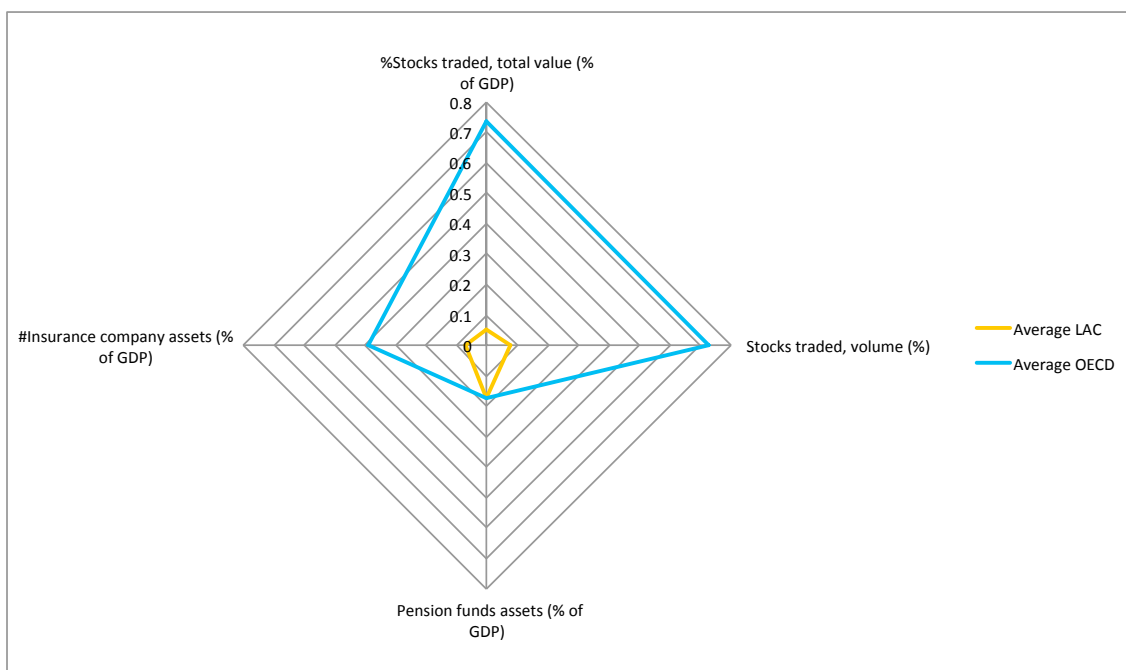
for investment compared to 40 percent in Asia and Europe, while 30 percent of enterprises point to the lack of access to credit as a significant protraction on their activities (OECD-ECLAC, 2013). Faced with these difficulties, some enterprises opt for self-exclusion and use their own funds, if available, or seek other sources of finance. The lack of access to credit limits the investments needed to access value chains or, more importantly, makes it difficult to manage the risks as a part of a chain. On occasion, this leads to individual loss, to loss throughout the chain, to the exit of an enterprise from the chain—or even to global chain destabilization.

Capital market development in LAC is still in its infancy. Stock exchanges are at the early stage of development compared to OECD countries and emerging economies (Figures 16 and 17) and they trade on fixed income, principally in public stocks. Variable income stock exchanges (shares, among others) are still of little value (shares in the region's stock exchanges do not exceed 40 percent of GDP compared to OECD countries where it is above 100 percent), and they lack liquidity (the average rotation rate of LAC share markets in 2007-11 was 8 percent compared to 73 percent in the OECD and 54 percent in the emerging economies).

The presence of other key institutional investors is limited. Although pension funds have a level of capitalization that is similar to that of OECD countries (approximately 17 percent of GDP for the period 2007–11) and are above the level of emerging economies (15 percent) (Figures 16 and 17), their portfolios focus only on public sector bonds and short-term bank deposits. There are few investment funds worth approximately 10 percent of GDP in capitalization (compared to 40 percent in OECD countries).

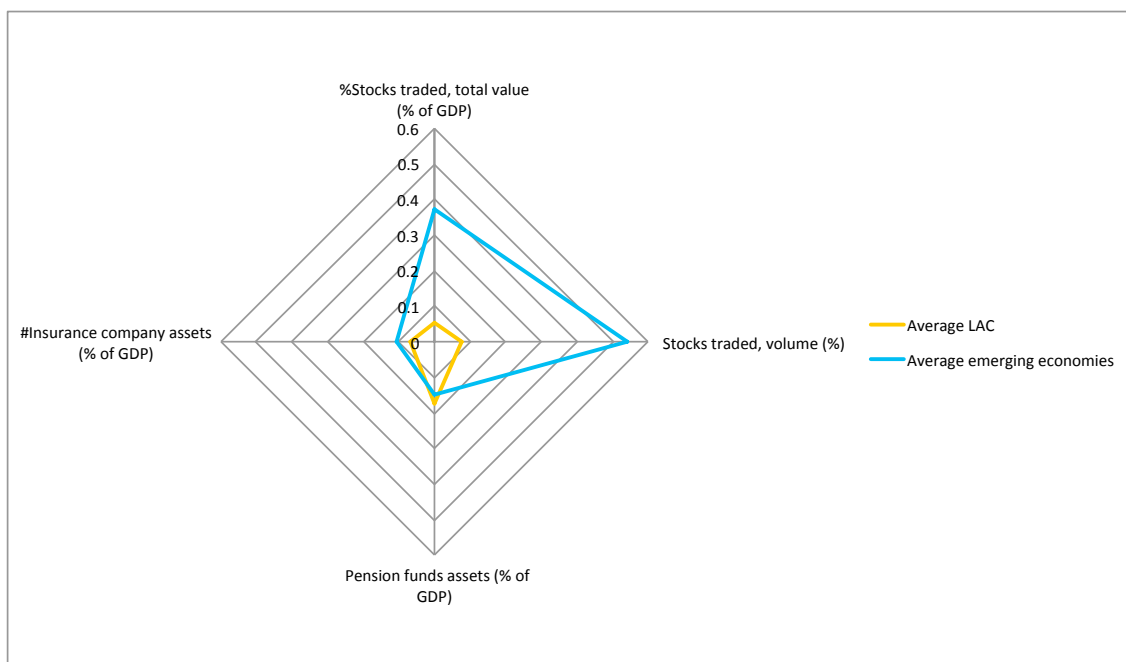
Risk management markets and instruments are at the early stage of development. Insurance sector assets only represent 7 percent of regional GDP in contrast to 39 percent in the OECD (Figure 16) and 11 percent in the emerging economies (Figure 17). Spending on insurance premiums in the LAC region is very low in relation to advanced economies, at less than 1 percent in life insurance and 2 percent in other insurance policies, while in OECD countries this spending represents 6.5 percent and 3.5 percent, respectively.

Figure 16. Performance in Latin America and the Caribbean compared to the Organisation for Economic Co-operation and Development, 2011–15



Source: Authors' elaboration based on World Bank (2014).

Figure 17. Performance in Latin America and the Caribbean compared to Emerging Economies, 2011–15

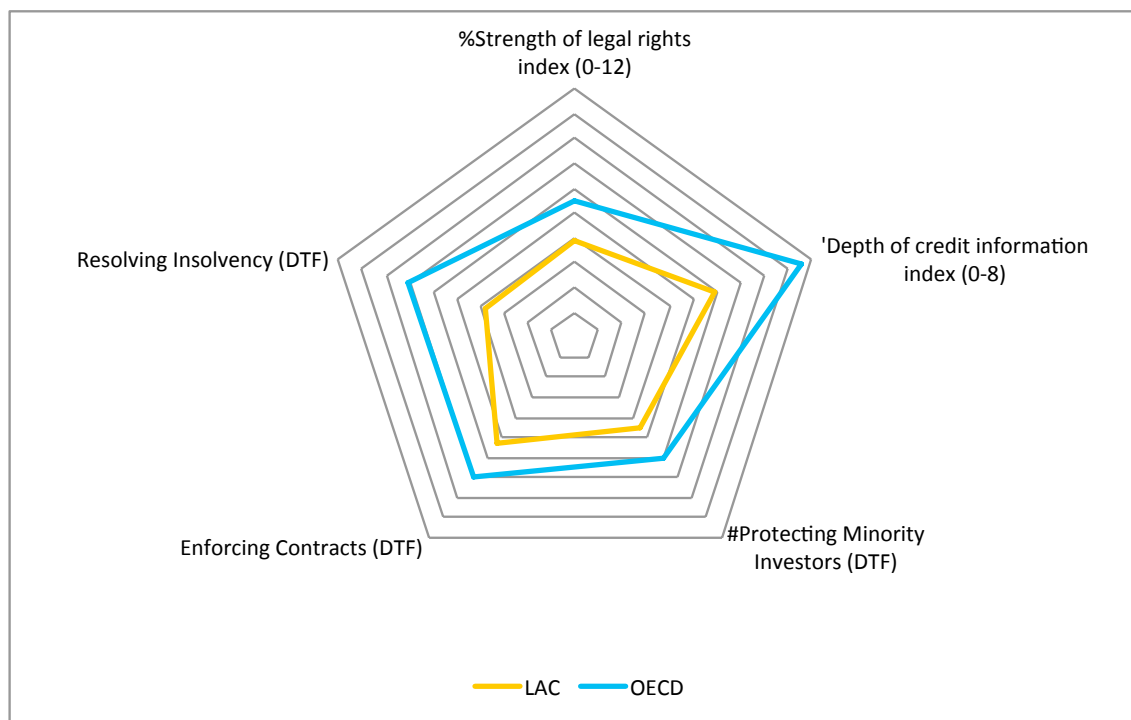


Source: Authors' elaboration based on World Bank (2014).

Restricted access to finance for the productive sector is influenced by the weak performance of institutional and regulatory frameworks. Financial markets

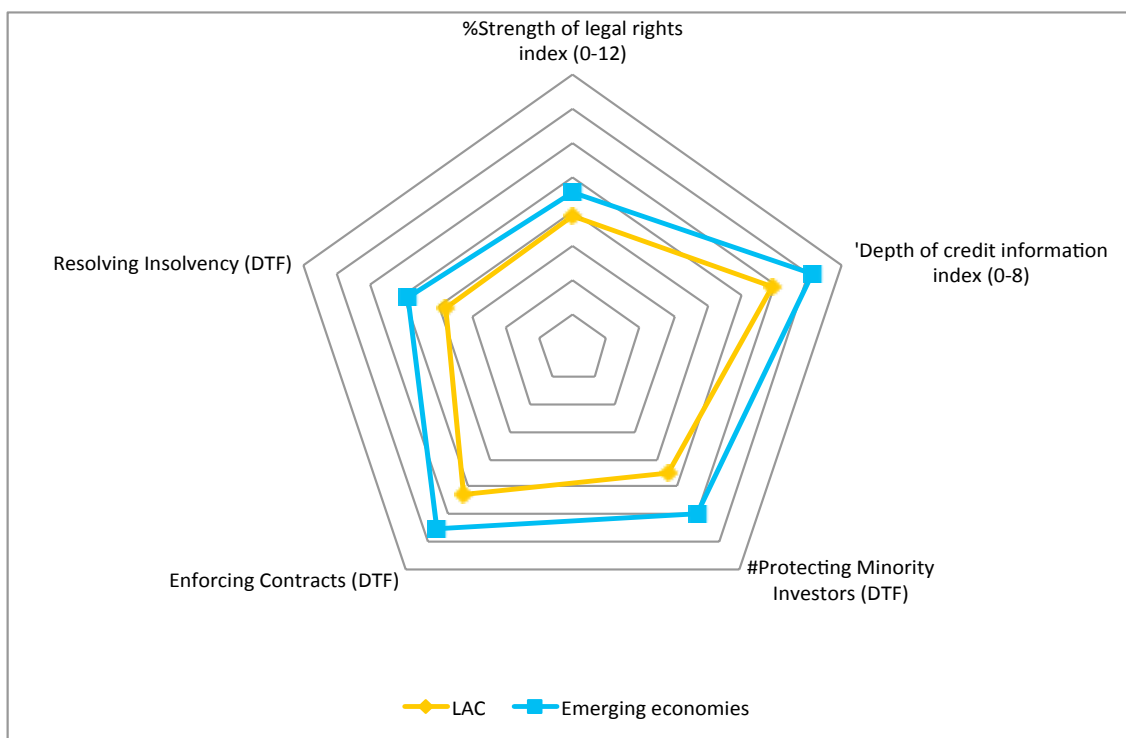
function within a complex contractual framework that aims to reduce information asymmetry and resolve the contract execution challenges that are inherent in selecting, monitoring and, ultimately, recovering financial assets. How efficiently financial market actors can structure and enforce their operations depends on a regulatory infrastructure that will facilitate information gathering and ensure contract compliance, as well as promote competition and innovation. In LAC countries, this institutional and regulatory framework is weak, especially when compared with other developing countries (Figures 18 and 19).

Figure 18. Performance in LAC compared to Organisation for Economic Co-operation and Development, 2011–15



Source: Authors' elaboration based on World Bank (2014).

Figure 19. Performance in Latin America and the Caribbean compared to Emerging Economies, 2011–15



Source: Authors' elaboration based on World Bank (2014).

4. The Role of Public Policy in Improving Risk Management for Values Chains in Latin America and the Caribbean

The lack of access to finance in LAC countries is a consequence of a series of failures in the financial market. Among the most significant are (i) incomplete markets, (ii) externalities, and (iii) failure of agents to coordinate and their strategic behavior. The prevalence of informal micro and small enterprises that have relatively low added value sectors; the fragile institutional and regulatory environment; the presence of uncertainty and information asymmetries; and the higher transaction and scale costs make the financial market in LAC finance the productive sector at a suboptimal level (IDB, 2014). Given the presence of market failures and suboptimal equilibria, there is a need for public policy action. Recently, the public sector implemented various value chain programs as one of its policy instruments, so as to improve access to finance for the productive sector.

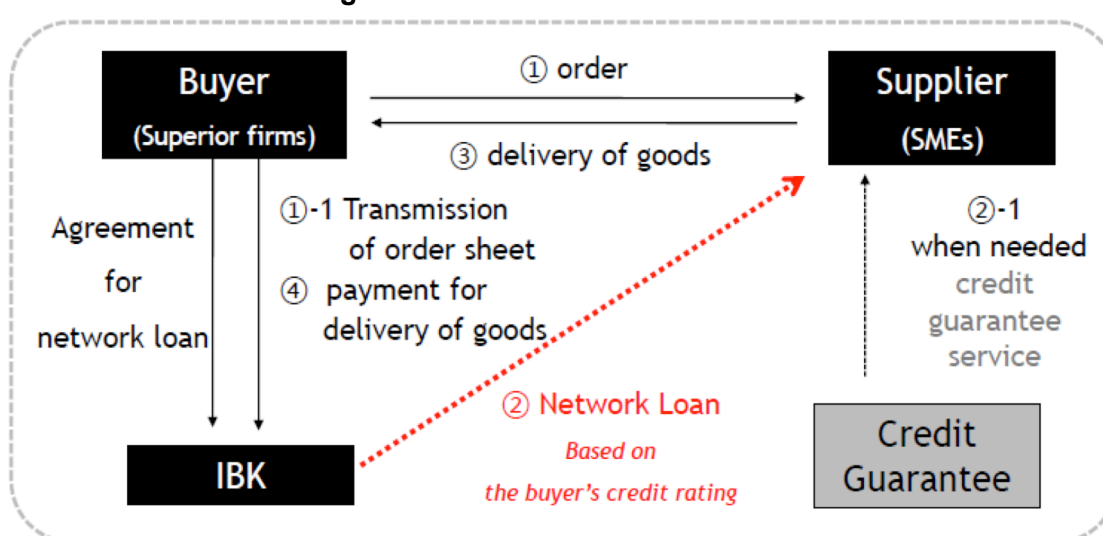
International experience illustrates the role that the public sector can play in promoting access to finance for and within value chains. For example, the so-called network loans provided by the Industrial Bank of Korea have enabled suppliers of medium and large enterprises to access finance. These loans are granted to suppliers on payment of pending invoices, with the contract between buyer and supplier as collateral. At the same time, loans are backed by public guarantee funds, allowing greater access to finance, especially for SMEs, at a lower cost than an individual loan (Box 1). Italy's government program, Business Networks (Reti d' Impresa), has successfully facilitated access to finance for Italian SMEs, particularly

during the unfavorable financial climate that followed the 2008-09 global financial crisis. In this case, the Cassa Depositi e Prestiti (CDP), the Italian public bank, channels resources to enterprises, using commercial banks as intermediaries. These banks, in turn, provided loans to firms that have signed a network contract with other enterprises. The network contract and the public guarantee funds make it possible for businesses to access finance at more favorable conditions, thus reducing costs between 15 percent and 30 percent (Box 2). A particularly significant initiative in Latin America is Mexico's National Productive Chains Program (Program de Cadenas Productivas de Nacional Financiera, or NAFIN), which promotes participation by SMEs in value chains. Suppliers that have contracts with enterprises or public institutions can obtain finance for outstanding accounts through electronic discounts on invoices before the payment due date at a more favorable rate and repayment period than through traditional channels (Box 3). In general, all these value chain programs have been successful in promoting better access to finance, especially SMEs, by enabling the contractual relationship between supplier and buyer to be used as collateral for the loan of the supplier. In effect, the latter model allows for greater risk diversification and better mitigation of the risks relating to asymmetric information and transaction costs that could tighten the supply of finance. Likewise, financial entities have benefited from the information supplied by actors regarding their partners within the chain. This has led to lower risk pricing and reduced financing costs for supplier firms. Finally, firms in receipt of credit have been able to build a credit history which is useful to obtain further credit.

Box 1. Network Loans: South Korea

A network loan is a product offered by the Industrial Bank of Korea (IBK) through which suppliers can access finance on the strength of their order sheets. IBK underwrites an agreement with the buyer, who must have a BBB credit rating or higher in order to sign the agreement. Thereafter, the buyer sends a purchase order to the supplier and to IBK. Following receipt of the purchase order, IBK provides a network loan to the supplier, according to the conditions stipulated in the agreement between IBK and the buyer, and up to 80 percent of the value of the purchase order. The loan is based on the buyer's credit rating, which reduces the interest rate. Likewise, it can be backed by public guarantee. An enterprise that obtains a network loan is offered a reduced interest rate at a minimum of 20 percent less than the norm, which is approximately 5 percent. The loan is repaid by the buyer once the merchandise has been delivered.

Diagram 1.1. Network Loan Flow Chart



Source: Industrial Bank of Korea (2013).

This product was launched by IBK in July 2004. Towards the end of 2014, 12,182 enterprises had taken advantage of this type of loan, representing US\$1,600 million. The network loan establishes a mutually beneficial relationship between the supplier and the buyer. While the supplier can obtain finance at more advantageous terms, the buyer can benefit from the lower financial costs that the supplier incurs to produce the goods. Samsung is an example of having participated in this program. The 2004 agreement between Samsung and IBK enabled 1,200 first-tier SMEs to gain access to finance. An agreement, signed in 2008, facilitated access to this type of loan to more than 3,800 second-tier small- and medium-size suppliers.

Box 2. Enterprise Network Program: Italy

Italy's Enterprise Network Program aims to foster the competitiveness of businesses, in particular small- and medium-size enterprises, by encouraging participation in and strengthening value chains. The Cassa Depositi e Prestiti (CDP) makes financial resources available to companies that have a network contract with other enterprises, which channels through intermediary commercial banks. A network contract is a legal form within Italian legislation since 2009. It contains the network's strategic objective—generally relating to innovation, competitive ability and/or access to markets—the duration, its members, and the rights and obligations of members, among other elements. Through a network contract, enterprises can oblige themselves for example, to collaborate in certain processes, exchange information, harmonize activities, or exchange goods or services.

There are many benefits for businesses, such as the ability to access or normalize participation in a value chain, obtain economies of scale, share knowledge, be tax exempt, have stronger bargaining power, better distribute risk, and be able to source finance under more advantageous terms. With regard to the latter, a network contract, together with public guarantee funds, will allow enterprises to access finance at more competitive rates and under better terms, thus reducing costs by 15–30 percent. According to the valuation of the banks participating in the program, such as BNL Paribas and UniCredit, a network contract that ensures that enterprises work together and share information will reduce asymmetric information, as well as the cost of screening and monitoring by commercial banks. Furthermore, it will decrease the risk of payment default, since it will increase the capacity of an enterprise to be more competitive.

The European Investment Bank has also participated in this program by providing a loan to the CDP in order to fund part of the credit line that targets enterprise networks. Likewise, the Export Credit Agency (Servizi Assicurativi del Commercio Estero, or SACE) has made guarantee funds available to shore up the loan portfolios of commercial banks. According to data from the Intesa San Paolo Observatory (2014), enterprises that participate in a network earn higher revenue than those that fail to do so as a consequence of better strategic positioning.

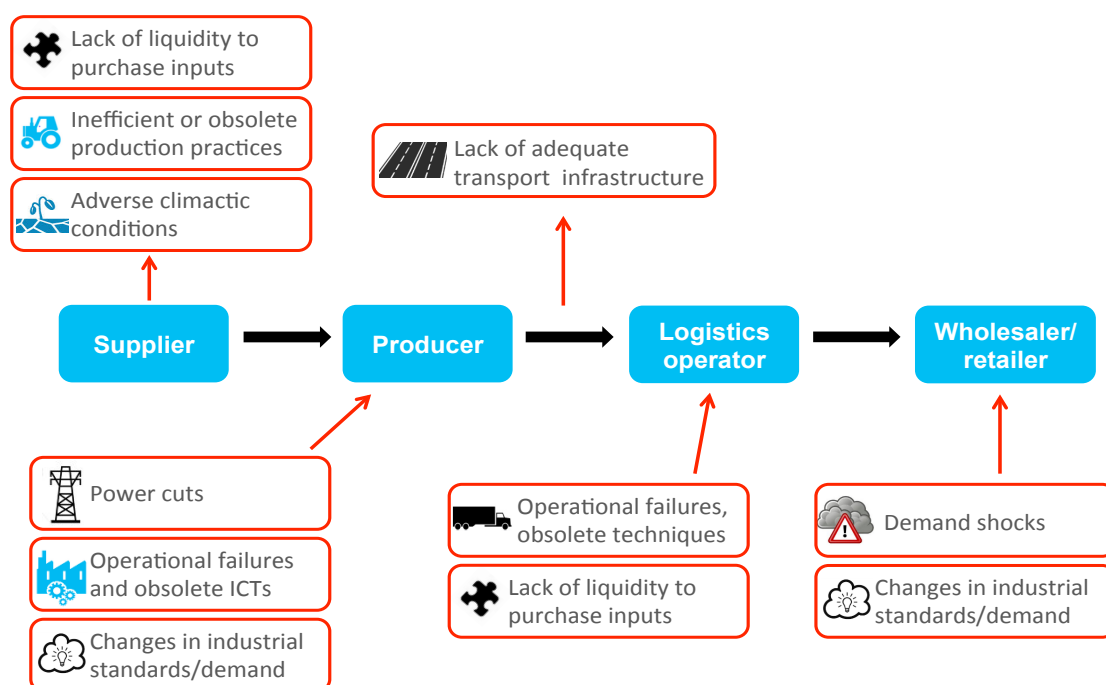
Box 3. Productive Chains Program: Mexico

This program promotes access to and strengthens productive chains through a factoring service that reduces liquidity restrictions for small- and medium-sized suppliers (those with less collateral and credit history). The program's technology infrastructure is designed to facilitate coordination, provide training to participating enterprises, and be able to refinance Tier 2 financial institutions. Participants in this program are large enterprises and government entities with low credit risk; their respective suppliers (usually SMEs); financial intermediaries willing to provide a discount to suppliers for buyer orders; and Nacional Financiera (NAFIN), which oversees the entire process. Buyers register their unpaid invoices from suppliers in the portal. Suppliers, in turn, can choose whether to discount them through participating financial intermediaries. Financial intermediaries then bid to discount the invoices. Publishing the invoices in the portal generates competition between financial intermediaries, resulting in lower discount rates. Once a financial intermediary has been selected, the supplier transfers the discounted invoice amount to the account of the supplier, thus ensuring that suppliers have access to liquidity through their outstanding accounts as a result of financial factoring and excluding the need to await the payment due date. NAFIN provides second-tier finance at attractive interest rates to participating financial intermediaries. The financing period is from 30 to 120 days with no commission. The program has been very successful and, to date, has assisted more than 100,000 SMEs. In addition to providing liquidity to suppliers, the program enables them to build a credit history which can be useful for obtaining longer-term finance. The program has motivated the creation of value chains, strengthened them, and improved cooperation and networking throughout.

An integrated approach to risk management leads to more effective value chain finance programs. Taking into account the risk classification presented in Section 2, it is worth highlighting that the previously mentioned programs—especially those implemented in South Korea and Mexico—focus on the prevention and mitigation of a key risk that may occur throughout value chains; supplier liquidity. Italy's program, as well as other programs designed to improve productive and technical capacity and the quality of goods of suppliers (e.g., producers of raw materials for whom there are numerous agricultural value chain finance programs) and services (e.g., programs that finance improvements for logistics services providers), focus on preventing and mitigating the market risks (e.g., financing the adaptation by agricultural producers to the phytosanitary standards of potential buyers) or operational risks (e.g., financing the acquisition by suppliers of new technologies). As shown in Figure 19, however, risks within a value chain are usually multiple and can be present in each node, as well as in the relationship between the nodes of the chain. In the example presented in Figure 20, the risks relating to the lack of liquidity for input purchase; inefficient or obsolete productive practices; or adverse climactic conditions can affect the quality and/or quantity of the inputs supplied to industrial producers. Simultaneously, power outages, operational failures, obsolete information and communications technologies, changes in industrial standards, or changes in demand can have negative effects on the products supplied to wholesale or retail distributors. The lack of suitable transport infrastructure, as well as operational failures, obsolete techniques, or the lack of liquidity for logistics operators can generate delays and/or shortfalls in the products to

be transported. Finally, demand shocks or changes in industrial standards can influence the demand for products from wholesalers or retailers and, in general, affect the overall stability of the entire chain. Given that an event that impacts on a node or segment of the chain can have consequences at the global level, a risk-based approach implies that management of such a risk must be comprehensive of the different participants in the value chain so as to achieve efficiencies, not only at the local level (in the specific node or segment), but also at the global level or throughout the entire chain. Practitioners may point to many cases where local approaches have failed to result in the desired impact. For example, some programs have financed the acquisition of technology and machinery within the agriculture sector to improve operational capacity in the supplier node, but have subsequently faced challenges in accessing the domestic or international markets because of a lack of suitable infrastructure and available transport services, the failure to adapt to the standards required by markets, or a failure to integrate the supplier's financial and product cycles.

Figure 20. Examples of Risks that Can Arise throughout A Value Chain



Effective management of value chain risks calls for an innovative and integrated approach to value chain finance programs, in an effort to address the various actors and issues and combine the most suitable financial and nonfinancial instruments for each situation. Following general practices of risk management, the design of integrated value chain finance programs involves three stages: identification, prioritization, and prevention and mitigation. The first stage relates to identifying, at the general level, the risks within specific chains and classifying them according to the type of risk (systemic, market, operational, credit, or liquidity). A survey should be made of the risks at the node level of the chain and within the links that connect them. Based on the risks identified, the second stage prioritizes them according to a series of criteria. The most common criteria are the probability of occurrence and the magnitude of impact. Other criteria include a possibility that the public sector can offer an effective

solution or that there is a cost-benefit ratio between the proposed solution and the desired results. The first two stages can reveal a combination of critical risks at the node level, at the global level, and/or at the level of the links that connect the nodes of the chain. The third stage relates to the design of financial solutions that will prevent/mitigate the key risks that have been identified, combining the most cost-effective financial and nonfinancial instruments. Among the financial instruments most commonly applied by public programs are credit, guarantees, and insurance funds, as well as supply chain finance. Training and technical assistance constitute the nonfinancial instruments usually included in such programs (dealt with in more detail in the following section). Value chain finance programs with an integrated risk management approach can therefore make use of the financial and nonfinancial instruments normally employed by the public sector for traditional programs. There is a difference, however, insofar as a program with an integrated risk management approach cannot put forward a local, “one-size-fits-all” solution; rather, the basis is on an evaluation of value chain barriers and requirements, in order to combine public policy instruments that will contribute to global efficiencies and to the most cost-effective arrangement for the public sector.

Greater access to finance for value chains in LAC would enable better risk management. Easier access to finance is essential to implement risk prevention and mitigation in value chains. While risks may arise at different levels, the various actors in the chain should be able to access finance. If they are unable to, the prevention/mitigation of risk may be jeopardized and could threaten the efficiency and stability of the chain. For example, finance is critical for an input or service provider to expand facilities or modernize machinery and processes, either to fulfill existing orders or to ensure compliance with the quality standards set by the buyer or industry. Likewise, it may be crucial for the various actors in a chain to adopt advanced information technologies, such as those with big data (Box 4) or the Internet of Things (Box 5), in order to better manage their operations and stimulate greater collaboration throughout the chain, among other objectives. Finally, it may be key to address liquidity restrictions and credit risks or to mitigate during infrastructure failures (e.g., power cuts) or in the instance of adverse climactic conditions (e.g., droughts, floods).

Prevention and mitigation actions that have been identified can be implemented by the private sector, but may also require public sector participation. Public goods and the existence of externalities and incomplete markets, among other elements, require public sector participation as a means to prevent or mitigate a specific risk. Examples of this are the construction of a laboratory for sanitary and phytosanitary analysis to ensure quality and reduce inspection times for export products; the building of suitable port infrastructure to improve security and enhance overseas trade efficiency; the establishment of transport and logistics infrastructures to improve access to markets; logistical process efficiency and security; and the design of programs to incentivize conversion to technologies with lower environmental impact. The public sector should also provide the necessary resources to support programs for investment and incentives that are needed to prevent/mitigate the risks that affect value chains. The public sector’s role is also essential to establish a reliable and stable regulatory framework that will stimulate better quality demand for finance by enterprises and increase the supply of finance from the financial sector.

Box 4. The Potential of Big Data for Value Chain Risk Management

Advances in the field of information technologies have made huge quantities of data available to businesses, along with the powerful analytical tools needed to obtain useful information. Big data analysis is, therefore, rapidly becoming a critical instrument with which to manage enterprises and their supply chains (Deloitte, 2015). Although there are various data gathering and analysis methodologies and models available, big data differs in three main aspects (Manyika et al., 2011; Varela and Tjahjono, 2014): (i) velocity, as the data are created, analyzed, and transferred with remarkable speed in real time or in nearly-real time; (ii) variation, based on the different types of data that change over time and according to context; and (iii) volume, where a huge quantity of data generated requires advanced analytical tools.

Although the adoption of big data is at an early stage, the potential benefit for value chain risk management is significant. Big data can provide more precise and reliable information, in real time, from different sources and in greater volume than the tools currently employed by enterprises as a means to predict events and guide decision making. This kind of information can improve the performance of risk analysis tools, process optimization (procurement, distribution), demand forecasting, traceability, integrated planning, and supplier/client collaboration.

An international survey carried out by Accenture (2014) reveals that businesses already using big data claim to have improved the reaction time for solving problems in their chains, enhanced efficiency, increased supplier/client integration, and optimized their inventories and asset productivity. For example, Amazon has radically reduced its logistical costs and delivery times by using big data to monitor 1,500 million products in its inventory in more than 200 storage facilities around the world. Specific tools predict when a client will buy a product and Amazon dispatches a pre-delivery to a warehouse close to the order destination.

The adoption of big data by a wider range of enterprises, however, remains limited by challenges such as the large investment required for its incorporation and use, security problems, and the shortage of human capital. The public sector can further diffuse these technologies, for example, by encouraging the supply of finance; establishing security standards; building anti-cybercrime infrastructure; strengthening existing regulations to ensure data privacy; increasing big data use and availability for public institutions; and supporting the construction of telecommunications infrastructure in areas where it is needed, in order to provide equitable access to the benefits that this type of technology offers.

Box 5. Risk Management in the Era of the Internet of Things

The emergence of the Internet of Things (IoT) can improve value chain risk management. IoT refers to sensors and other types of instruments that can connect objects and machinery to computing systems (McKinsey, 2015). These systems enable the performance and the state of equipment, products, systems, and so on, to be remotely monitored and managed. With regard to enterprises and their value chains, IoT can help to improve efficiency, thus maximizing physical assets and optimizing operations management. Recent studies show that the following operations benefit significantly:

- Inventory management: through more precise and reliable monitoring of inventories and inputs that flow across the actors and processes involved in the supply chain (e.g., in the warehouses of enterprises and their suppliers, in final-sale businesses, in mediums of transportation);
- Equipment maintenance: by location sensors capable of reporting on machinery performance and physical assets, indicating when maintenance is required, and thus avoiding damage and disruption in the chain.
- Energy management: by using so-called “smart” sensors and meters to improve energy efficiency;
- Risk prevention and mitigation in terms of security and health; and
- Product development and marketing: by using big data, so as to be able to predict changes in consumer preferences.

According to McKinsey's estimates (2015), wider implementation of IoT in supply chain operations management by the year 2025 could significantly increase efficiency and generate savings of approximately US\$7,000 million on a global basis. In particular, the study highlights the fact that the use of IoT in business-to-business applications can generate greater value for the economy than its use in applications designed for consumers. This is because greater interconnection and interoperability between productive processes and systems can reduce costs, enhance efficiency, and minimize the risk of disruptions. For example, General Electric installs sensors in the reaction engines it builds for the aerospace industry, which are connected to a cloud-based platform. These sensors transmit data useful for predicting maintenance requirements and periods, used by General Electric's maintenance department and by the suppliers of related services. Implementing this technology has made it possible to reduce maintenance costs and the number of canceled flights while simultaneously ensuring greater reliability and higher customer satisfaction (Iansiti and Lakhani, 2014).

The benefits of implementing IoT are wide-ranging and include many actors. It can improve the visibility and collaboration between supply, processing, logistics, wholesale, and retail enterprises, leading to greater optimization in the different processes of a value chain; better pricing and customer loyalty strategies; enhanced risk management capacity; faster and more effective decision making; and higher earnings. Financial institutions can benefit from increased availability of real time data about, for example, the level of utilization of fixed assets, procurement and sales, inventory levels, and so forth, upon which to base their financing strategies or credit monitoring. Finally, the economy in general can benefit from higher levels of efficiency and productivity.

The public sector can play a key role in promoting the implementation of IoT. Among other functions, public sector participation will be crucial for establishing standards that facilitate interoperability, protect user and business privacy, safeguard intellectual property, strengthen regulation in security matters, help in the fight against cyber espionage and cybercrime, and reinforce clear and efficient legal procedures for regulation compliance. In general, the public sector's critical mission will be to create and protect a favorable environment to facilitate the adoption of IoT, so as to maximize its benefits and eliminate or minimize the risks that new technology may generate.

Development banks and specialized public agencies can play a key role in the design of value chain risk management strategies. A development bank's mandate is to foster socioeconomic development by financing specific economic activities, sectors, or segments (IDB-CMF, 2013). Development banks are therefore key actors in designing and coordinating finance strategies to promote investments in economic sectors or segments of the market where there are multiple risks and/or barriers between the supply of and demand for finance. Development banks occupy a particularly privileged position with regard to value chains, as they can simultaneously manage finance and risk management instruments and provide technical assistance resources—all necessary elements to implement risk prevention and mitigation actions that could otherwise be hampered by the lack of access to finance. In many countries in the region, development banks already play a leading role by promoting greater access to, and higher efficiency in, value chains by way of credit and guarantee funds and factoring. For example, in Brazil, the National Bank of Economic and Social Development (Banco Nacional de Desenvolvimento Econômico y Social, or BNDS) supports the development of a wide variety of chains by facilitating access to finance for its components, either directly or through so-called anchor companies. In Mexico, NAFIN's Value Chain Program has put forward an innovative solution to supplier liquidity problems by using electronic factoring. Specialized agencies, such as ministries of economy or industry and development organizations, can also take a lead role in designing risk management strategies, insofar as they have a mandate to develop the productive sector through different programs and instruments. An example of this is the San Juan Provincial Development Agency (Agencia de Desarrollo de la Provincia de San Juan) in Argentina. This agency has played a significant part in designing and implementing a program to develop the province's productive sector by providing "tailored" support for the main value chains present in the area, and combining financial and nonfinancial support to strengthen them (see Box 9).

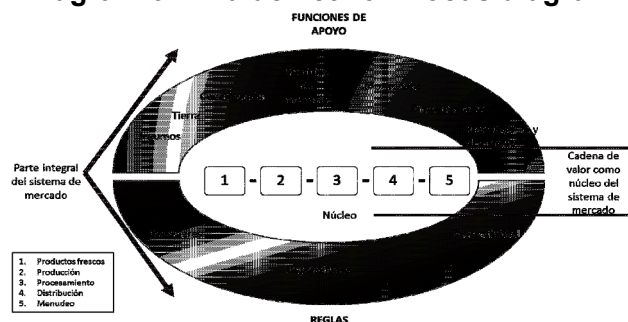
Due to their mandate, the capacity of development banks to elaborate and leverage finance strategies for productive sector development, and their experience in value chain strengthening can, in the future, play a key role in the drafting and implementing finance strategies for integrated value chain risk management. As previously mentioned, risks are present at various levels in value chains, requiring an integrated strategy to achieve effective solutions at the global level. At present, elaborating and adopting such a strategy is limited by at least four factors: (i) failing to identify risks at the global level and the appropriate actions to prevent and mitigate them; (ii) the lack of coordination among private sector actors participating in a chain, who take decisions to maximize their local positions, paying little heed to the consequences at the global level; (iii) private and public sector coordination failures, and coordination within the latter, to identify barriers that require appropriate intervention; and (iv) restricted access to the finance needed for risk prevention and mitigation. These obstacles call for a proactive initiative to coordinate the different actors and sectors, based on a collaborative strategy to identify risks, mitigate them, and leverage resources and competencies from one to the other to achieve optimal value chain operation. Development banks that promote access to finance have the necessary experience and instruments to strengthen value chains, and they can play a strategic role. These banks can lead the design and implementation of risk prevention and mitigation strategies, as well as combine

different financial and nonfinancial instruments to address the risks and barriers faced by investment project financing. They can also mobilize domestic and international finance resources and coordinate the activities of diverse public and private actors, at the same time encouraging collaboration and thus reducing value chain vulnerability at the global level. Value chain finance programs are therefore something more than an alternative instrument that development banks can offer in place of commercial banks, since these programs can more effectively organize and facilitate resources and enhance value chain competitiveness. In other words, value chain finance programs represent an essential element within a development strategy in order to expand the product space and increase economic growth. An example is the work that the Trust Fund for Rural Development (Fideicomisos Instituidos con Relación a la Agricultura, or FIRA) has carried out in agricultural value chains in Mexico. In effect, FIRA conducts comprehensive mapping to identify the barriers, risks, and necessary finance in each chain with a view to develop made-to-measure programs (Box 6).

Box 6. Analysis Methodology and Mapping of Value Networks: The Experience of FIRA

As a Tier-2 financial institution, the Trust Fund for Rural Development (Fideicomisos Instituidos con Relación a la Agricultura, or FIRA) fosters and promotes funding by banking and nonbanking financial institutions to the agri-food sector in Mexico. Through the analysis and mapping of the value networks in this sector, FIRA examines the structure and operation of agricultural production, in order to identify the financing needs of producers and enterprises engaged in agricultural activities, determine their level of competitiveness, and propose risk mitigation instruments. The following aspects, among others, are analyzed: (i) the vertical structure of the different production links in the value networks, based on an analysis of the final market and an appraisal of the inputs market; (ii) the horizontal structure of the value networks, made up of the different services (e.g., technical, financial) that support productive activities, as well as the existing links between participating economic agents in their formal and informal relationships; and (iii) governance in the links of the value chain network relating to the coordination and management mechanisms that may exist between participating economic agents. Based on the results of the studies, FIRA intends to develop products and innovative financial schemes to suit each value chain's characteristics so as to encourage increased flows of finance from banking and nonbanking financial institutions towards productive activities in the agri-food sector. Likewise, identifying the major risks faced by these different producers and enterprises throughout the value networks can, on the one hand, encourage a risk management culture among the producers and enterprises that comprise such networks and, on the other, induce participation by financial intermediaries in developing and applying integrated financial credit and risk management schemes.

Diagram 6.1. Value network focus diagram



Coordinating and leveraging the programs implemented by other actors is essential to develop financing strategies for integrated value chain risk management. Given that the type of risks that affect value chains are various and originate due to different factors, and they will need to be managed by different actors, it is important to identify which actors should be involved in the strategy design. For example, to improve the quality of the transport infrastructure will require liaising with the Ministry of Public Works or the corresponding agency. Raising the standards of quality of a certain product or input will require collaboration with public sector agencies, such as those that oversee health, industrial regulation, or facilitate international trade. Increasing innovation and adopting new technologies will also require coordinating with those public agencies responsible for promoting science and technology. It is also fundamental to ensure that there are partnerships with those public entities responsible for industrial and/or economic policy, as well as with the sector or territorial development agencies. This way, strategies can be aligned with national and territorial development policies and synergies can be assured with already existing initiatives in order to avoid duplication. Work can be undertaken jointly in relevant areas, while at the same time, knowledge from these institutions can be gained for the design and implementation of the strategies. Liaising with the private sector is also fundamental. The successful initiatives described above demonstrate constant dialogue and collaboration between the public and private sectors in various countries. There should also be dialogue with the private sector (including actors such as large enterprises (Box 7) and SMEs), partners between enterprises belonging to the different links of the chain, suppliers of different types of services (e.g., certification, security, technology), and financial service providers. With regard to the latter, it would be useful to include them in the strategic dialogue, given the nascent significance of nontraditional actors (Box 8). Finally, all strategies should observe the international social and environmental standards to which the IDB subscribes.

Box 7. Large Enterprises: Towards Greater Collaboration

Large manufacturing enterprises and distributors/retailers play a key role in value chain risk management. In general, these enterprises hold greater technical, human, and financial capacities to (i) identify risk; (ii) design risk management strategies; (iii) implement early warning mechanisms; (iv) implement monitoring systems; (v) instigate risk prevention or mitigation actions; and (vi) promote greater collaboration between suppliers and clients. Likewise, these enterprises are much closer to the final consumer and, therefore, can better predict and react more quickly to one of the most significant risks facing any business: volatility and change in demand.

Previously, when the various processes and product cycles of an enterprise took place in house and independently, the productive and value added processes were more efficiently managed. In modern industrial organization, however, efficient management of the value chain and its associated risks has increased in complexity, interdependence, and interconnection, requiring close collaboration between suppliers and clients. Although the literature in this field highlights the benefits of collaboration and integration—and the fact that technological advances have enabled the exchange of information to take place in real time in parallel with greater systems and productive process interconnectivity—in practice, this is far from complete.

Among the key obstacles in risk management that hinder the collaboration between suppliers and clients are transactions and financial costs. Nonetheless, international experience demonstrates that the benefits of collaboration largely exceed the associated costs. For example, data from Brazil's program, Encadear, implemented by (Servicio Brasileño de Apoyo a las Micro y Pequeñas Enterprises, or SEBRAE), indicates that closer collaboration among leading businesses and their suppliers has enabled the latter to improve their technical, administrative, and financial capacities. Leading businesses have acknowledged input quality improvement and greater flexibility from suppliers in the case of emergency, and value chain performance has reached optimum levels. The study, conducted by Arráiz, Henríquez, and Stucchi (2013) on Chile's Suppliers Development Program (Programa de Desarrollo de Proveedores), shows that this program has had a positive impact, not only on the suppliers (in terms of sales, number of employees, and sustainability) but also on the anchor company (in terms of sales and exports), resulting in the latter having benefited from the earnings of the former. It is because of these advantages that large enterprises continue to participate in programs that strengthen suppliers. This also applies to Samsung, for example, which partners with the Industrial Bank of Korea to provide network loans to its suppliers, helping them gain access to finance for working and investment capital. Examples of large enterprises, such as BMW and Ericsson (referred to in Section 2), demonstrate that the cost of failing to collaborate between parties can be higher than doing so.

Box 8. Alternative Finance for the Productive Sector

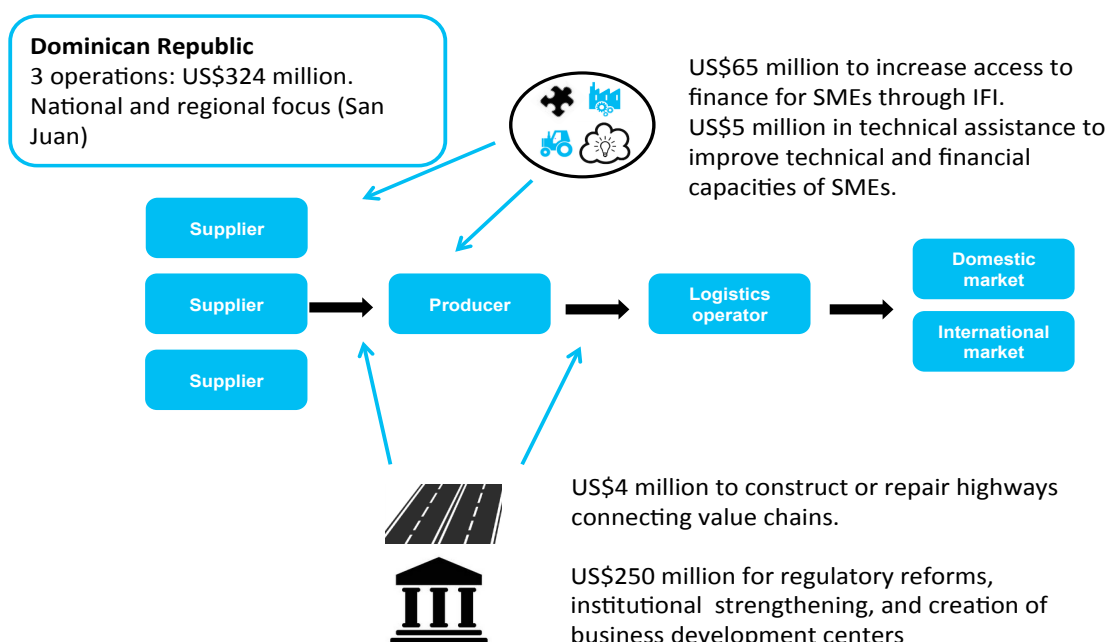
Advances in communications technologies have given rise to a new business paradigm in terms of finance—referred to as alternative finance or crowdfunding. This term is used to describe small quantities of money that are obtained from a large number of individuals or organizations, by means of web platforms or mobile applications, to finance an individual, a project, or a business (Kirby and Worner, 2014). Among the various crowdfunding categories are donations, loans, and shares. This new paradigm has disrupted the world of finance, since platforms, such as Lending Club, Prosper, or Ondeck, can offer individuals or organizations investment opportunities, where the technology itself is the only intermediary. Likewise, different screening processes and scoring techniques are used, whereby the applicant's credit profile is examined, using traditional and non-traditional methods that include, among the latter, their social media profiles, online shopping habits, and so forth. Investors are able to view each applicant's credit rating and select the level at which they wish to invest. Since there is a lack of access to finance by the productive sector, especially SMEs, crowdfunding is fast becoming an alternative to obtain resources for working capital to invest in machinery, technology, innovation, and small infrastructure. Despite the potential of these new sources of finance, however, there are key concerns (e.g., investor protection with regard to project risk or platform default), fraud, illiquidity, or cybercrime, among others. National and international regulations have some way to go yet with regard to such challenges.

5. The Inter-American Development Bank as Strategic Partner in Integrated Value Chain Risk Management

Over recent decades, the IDB has acted as a strategic partner in the LAC region with regard to the design of public policy and programs to improve access to finance for the productive sector. In its work with the public sector, and especially with development banks, the IDB acts as a prestigious broker and/or catalyst in formulating policies to further extend access to finance and implementing programs to improve business capacities and foster private sector development in key areas of LAC economies. Likewise, the IDB facilitates the creation of networks at the national and international levels that will foster dialogue and collaboration, and which will spread best practices in the search for and design of solutions to the restrictions of productive financing. The IDB has supported numerous access-to-finance programs for value chains in the region. In Nicaragua, the US\$20 million program, Access to Credit in Rural Productive Chains (Acceso al Crédito en Cadenas Productivas Rurales), resulted in an integrated solution to finance and technical assistance needs in the dairy products and cocoa value chains. Three instruments were designed: (i) a credit guarantee program to mitigate perceived risk in the financial system regarding loans to this sector; (ii) a credit program to use as collateral for loans to small- and medium-size producers; and (iii) a technical assistance program to effectively improve productive processes and facilitate integration by small- and medium-size producers into value chains. Similarly, in the Dominican Republic, the IDB supported the strengthening of value chains with three operations totaling US\$324 million, combining financial instruments (financing and guarantee funds to facilitate access to medium- and long-term finance), nonfinancial instruments (technical assistance funds to improve access to finance and quality management), regulatory reforms to improve the business climate, and institutional strengthening tools (by creating business development

centers) to address the needs and risks identified in the country's main value chains (Figure 21).

Figure 21. Value Chain Strengthening Programs in the Dominican Republic

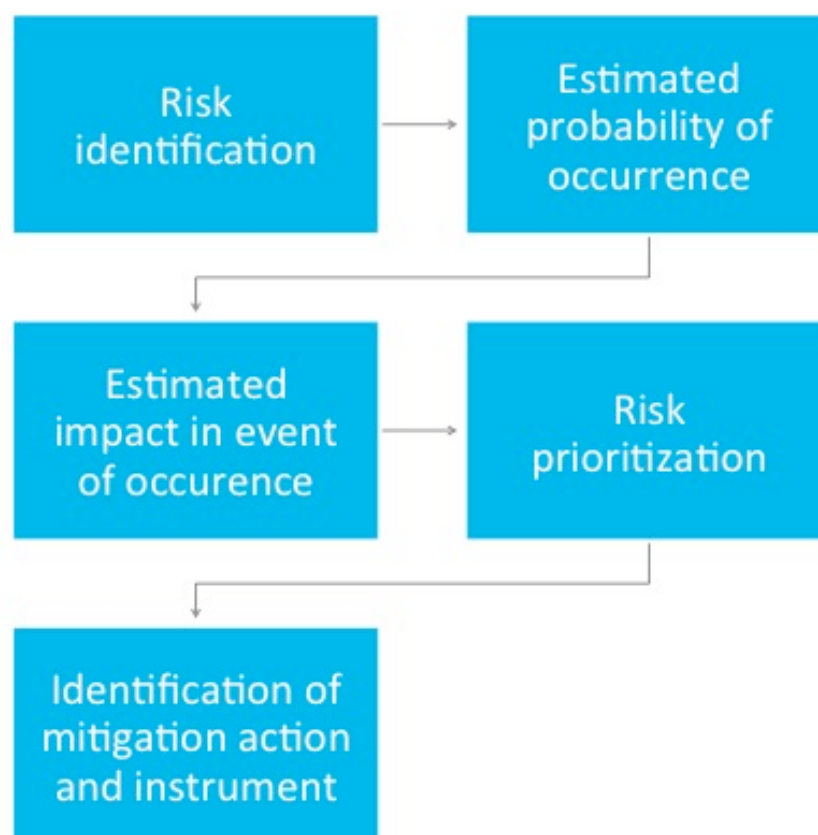


Box 9. Value Chain Risk Management: Argentina

With the support of the IDB, the Province of San Juan in Argentina established in 2009 an integrated value chain management program to boost economic growth and job creation in the province. The Production and Employment Development Credit Program (Programa de Crédito para el Desarrollo de la Producción y el Empleo), worth US\$31.95 million, combined financial and nonfinancial instruments to address the needs of value chains. On the one hand, the program made funds available to increase the supply of long-term finance to businesses, especially SMEs, to enable them to improve infrastructure, machinery, technology, and productive processes. Two funds were set up for this purpose: (i) a credit fund provided to banks by way of an innovative auction mechanism, managed by the Central Bank of Argentina (Banco Central de Argentina), and (ii) a guarantee fund for bank portfolios. These funds provided the means to decrease the risk perceived by the financial sector and to fund the costs for businesses. On the other hand, technical assistance funds were allocated to develop chain restructuring plans, design business plans for enterprises, and improve technical, financial, and management capacities. The program provided tailored support for different enterprises that related to the chain. For example, for those enterprises that were not part of the chain, more technical assistance components were used to reach the quality and quantity standards required for chain integration. Finally, the program established the Investment Development Agency (Agencia de Desarrollo de Inversiones), a space wherein the public and private sectors collaborate to draft the policies that are essential to improve value chain competitiveness. The results of this program have been extremely positive in that participating enterprises achieved 15 percent higher growth in exports and 75 percent higher growth in sales than nonparticipating enterprises.

The above programs identify a combination of instruments, according to the risks faced by enterprises and their beneficiary value chains. An effective risk management strategy requires a combination of various financial instruments that can be adapted to the needs of the value chain. Firstly, the risks that affect a value chain in its different nodes and links should be recognized. The main source of information are the actors that participate in the chain, since they are aware of their own barriers and risks. In addition to the productive sector, other key actors in the chain are the public institutions that provide financial and nonfinancial services, monitoring entities (e.g., customs and sanitary services), and research institutions. Secondly, the possibility of a risk occurrence should be evaluated by applying quantitative, qualitative, or mixed techniques, according to each case. Thirdly, the impact that the occurrence of a risk might have on the value chain should be calculated. Once again, quantitative, qualitative, or mixed techniques can be applied, according to the risk and the information available. Fourthly, the risks must be prioritized, based on the probability of occurrence and their possible impact. Prioritization can be influenced by effective public sector solutions, as well as by the cost-benefit ratio between the proposed solution and the desired results. Finally, an appropriate instrument for mitigation should be selected for each risk priority (Figure 22). Furthermore, since risks can change over time, the strategy in place should be reviewed periodically to update management intervention and to reassess the magnitude of the risk and its priority.

Figure 22. Flow Chart for Value Chain Risk Management Program Design



The IDB makes a variety of instruments available to LAC countries to improve integrated value chain risk management in the region. The following section presents a brief description of these instruments.

- a. **Investment loans:** One of the objectives of the lines of credit for LAC countries offered by the IDB is to facilitate the supply of public goods, stimulate the flow of credit and capital, create new financial instruments, and provide credit and investment incentives to productive enterprises. These lines are conducive to mitigating the different types of risk (e.g., operational, market, and liquidity). These loans have proved successful in expanding the frontier of finance as a result of the following instruments, thus resolving the challenges that LAC enterprises face in terms of access to finance.
- *Credit funds* are usually created by development banks and are used (i) to alleviate long-term funding issues, in particular with regard to investment, innovation, new technology adoption, and climate change adaptation, as well as in the productive sector; and (ii) as a price signaling mechanism for the private sector. Development banks provide these resources directly to individual enterprises (e.g., SMEs or anchor companies, so that the enterprises, in turn, onlend to their own goods and services providers) or combinations of enterprises (e.g., partnerships). Funds can also be channeled through commercial banks or other financial entities (e.g., cooperatives).
 - *Guarantee funds* are used by commercial banks as collateral for the productive sector, ensuring the efficient flow of finance to various sectors, especially those with low levels of collateral (e.g., agriculture, new enterprises, or innovation-intensive businesses).
 - *Funding for new financial instruments* that seek to promote the operation of unattended markets in which the private sector is unable to manage risk (e.g., weather and climate risk insurance, renewable energy, energy efficiency). With respect to the private sector, the IDB works with the region's governments to create incentives for enterprises to adopt more efficient technologies and practices to generate savings and promote greater sustainability of productive processes (Box 10).
- b. **Policy reform loans:** Lines of finance to support the regulatory reforms needed to improve the business climate and mitigate the systemic risks that occur in value chains.
- c. **Guarantee programs:** Guarantee of the loans provided by private financial institutions to the public and private sectors in LAC, in order to promote investment (mainly in infrastructure) and mitigate systemic risks (in the event of political or macroeconomic instability) and operational risks (improve the infrastructure availability and capacity needed for optimal value chain performance).

Box 10. Environmental Sustainability and Value Chain Efficiency

In recent years, enterprises have begun to examine ways in which to ensure sustainability and the efficient use of resources in their value chains. They seek to (i) reduce costs and optimize processes, and (ii) adapt to environmental and social standards, while at the same time, maintain a positive corporate image vis-à-vis their clients (Schaltegger and Burritt, 2014). According to the United Nations Global Compact Office (2010), sustainable value chain management is defined as the management of environmental, social, and economic impacts and the adoption of best corporate governance practices throughout the entire life cycle of a product. This may include practices such as (i) eco-design, relating to the design of products to minimize energy consumption, avoid dangerous materials during production, and reuse or recycle a product or its parts; (ii) ecological contracting, in order to cooperate with suppliers so that inputs are environmentally sustainable; (iii) energy efficiency programs to minimize energy consumption throughout the chain; and (iv) green information systems to monitor implementation of sustainable practices and their evaluate their results (Zhu, Sarkis and Lai, 2008).

The objective of sustainable management is to create, protect, and improve environmental, social, and economic value for all the actors in a chain, in parallel to the adaptation to regulatory developments and consumer preferences. Participants should put forth their effort to ensure the achievement of sustainability objectives at the value chain level (Vasileiou and Morris, 2006). To do so, various enterprises have established programs to enhance the sustainability of the value chains in which they participate. For example, Philips has developed the Supplier Sustainability Involvement Program, whereby sustainable practices are agreed, risks are monitored, and participants collaborate to correct deviations or forestall any problems that may arise.

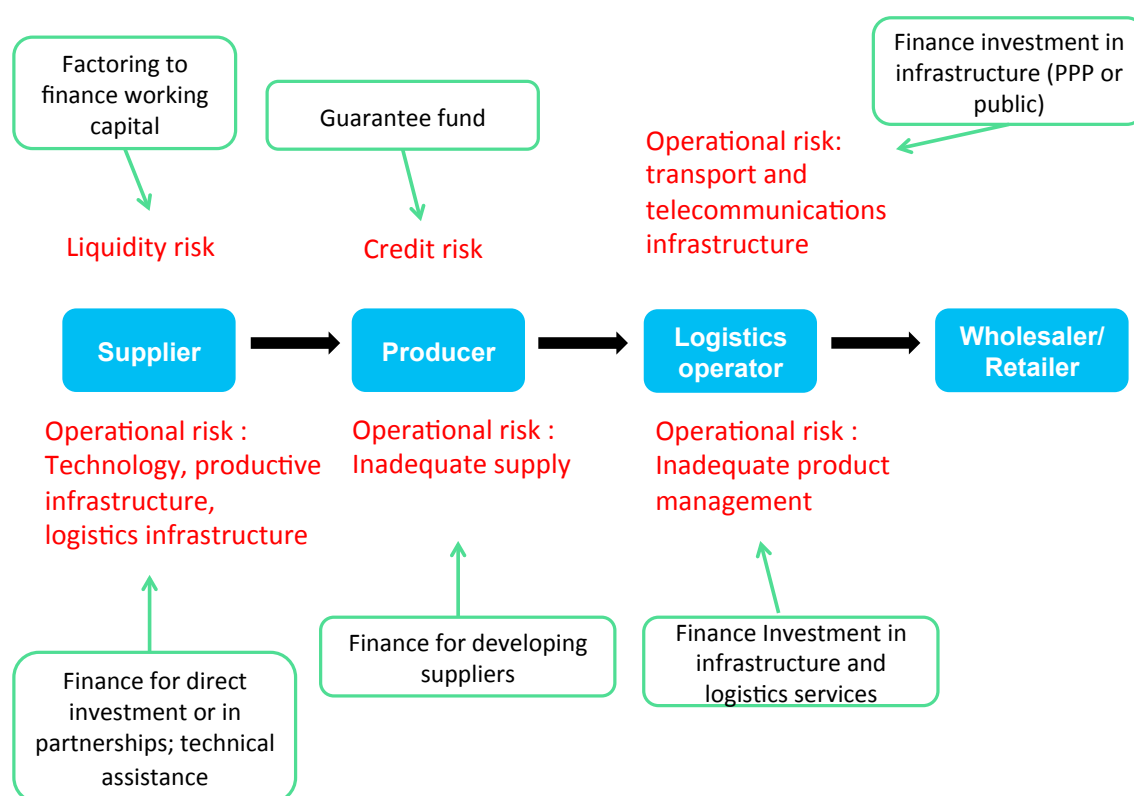
In the pursuit of greater sustainability, many governments encourage the adoption of more efficient energy technologies, especially in the case of SMEs. In LAC, some countries have implemented programs, with the support of the IDB, to reduce the investment risk of energy efficiency for enterprises and financial institutions. Support from the financial sector for this type of project in the region, however, has been negligible due to perceived the high risk and the lack of information relating to SMEs, in general, as well as the performance outcome of these projects, in particular.

To overcome these challenges, development banks have designed programs to provide (i) long-term loans for investments in energy efficiency technologies and (ii) insurance for enterprises and their financiers to mitigate payment failure in the event that energy savings are lower than projected. The significant support of the IDB in these programs has resulted in the availability of long-term lines of finance to development banks for Tier-2 onlending to businesses. The IDB has contributed its own resources and leveraged those of international donors for technical assistance in the design of programs and insurance instruments. It has also guaranteed investment training with regard to energy efficiency for firms and financial institutions.

- d. **Nonfinancial instruments:** Donor assistance or international funding to strengthen technical capacity building of the financial sector (e.g., improve investment project evaluation and monitoring capacities), as well as of the productive sector (e.g., improve creditworthiness). With regard to the productive sector, technical assistance resources for enterprises contribute to (i) sending a positive signal to financial entities regarding projects of potential clients; ii) improving the quality of key information regarding the credit risk of potential clients; and (iii) increasing the capacity of clients to pay, based on the support they receive relating to business performance. Similarly, these resources help to undertake value chain diagnostics to improve the technical capacities of enterprises and institutions.

Financial and nonfinancial instruments are complementary; combining them generates synergies that can overcome the challenges of integrated value chain risk management. Figure 23 shows the risks that have been identified in a value chain, as well as the combination of instruments that can be employed to mitigate them. The figure shows that the value chain diagnostic has identified the various risks at the node level and within the links between the nodes. At the supplier level, operational risk (due to obsolete techniques and the lack of suitable productive and logistical infrastructure) are present, as is liquidity risk. With regard to operational risk, a combination of investment finance (specifically for enterprises or through partnerships) and technical assistance could prevent or mitigate the risk. For liquidity risk, factoring or lines of finance for working capital are possible. At the producer level, there are credit risks (from unpaid invoices) and operational risks as a result of a lack of production inputs of sufficient quantity and quality. These threats can be mitigated by guarantee funds with respect to credit risk, and by creating a line of finance for supplier development with regard to an operational threat. At the level of the logistics operator, operational risk is caused by inadequate product management as a result of a deficiency in appropriate equipment and infrastructure. In this case, investment finance in infrastructure and logistics services should be made available. At the links level, the risks identified relate to transport and communications infrastructures, causing delays or disruptions in the chain. Investment finance can be made available for infrastructure, either through the public sector or through public–private partnerships, and can be backed by guarantee programs as a means to stimulate private sector participation. Finally, the mitigation of systemic and operational risk due to business climate deficiencies and macro-financial instability can be supported by the extension of loans for regulatory policy reform. It is possible that a variety of combinations of instruments are available beyond what is demonstrated in this example, based on the type of risk, the source of the risk, and the most cost-effective method for risk prevention/mitigation. Table 2 presents a summary of the most common types of risks in the region and some of the methods available to prevent/mitigate them through programs that support development banks to achieve integrated value chain risk management in LAC.

Figure 23. Examples of Risks and the Instruments of Prevention/Mitigation



The combination of instruments are varied, according to the context of the intervention, the risks involved, and the prevention/mitigation strategy. Table 2 presents a panorama of different types of risk, sources, probability of occurrence and magnitude of impact, examples of different methods of prevention or mitigation, and the various financial and nonfinancial instruments that are offered by the IDB to mitigate such risks. The IDB makes available a combination of instruments to its partners in the region, which can be adapted to specific value chain needs.

Table 2. Risks, Sources, Methods of Prevention/Mitigation, and Applicable Instruments

Type of risk	Source of risk	Probability of occurrence	Magnitude of impact	Mitigation action	Instrument
Operational	Mechanical, technical or process failure	Medium	High	<ul style="list-style-type: none"> • Machinery modernization/ maintenance • Improve processes • Technical training 	<ul style="list-style-type: none"> • Investment finance • Working capital finance • Technical assistance • Insurance
Operational	Forecasting error	Low	Medium	<ul style="list-style-type: none"> • Improve business skills • Increase visibility 	<ul style="list-style-type: none"> • Technical assistance • Partnership incentives
Operational	Energy infrastructure failure	Medium	High	<ul style="list-style-type: none"> • Process optimization • Investment in infrastructure 	<ul style="list-style-type: none"> • Investment finance • Technical assistance • Guarantee • Regulatory reform • Institutional strengthening
Operational	Communications infrastructure failure	Medium	Medium	<ul style="list-style-type: none"> • Process optimization • Investment in infrastructure • Regulatory reform • Institutional strengthening 	<ul style="list-style-type: none"> • Investment finance • Technical assistance • Guarantee • Policy reform finance
Operational	Transport infrastructure failure	Medium	High	<ul style="list-style-type: none"> • Process optimization • Investment in infrastructure • Increase visibility and collaboration • Regulatory reform • Institutional strengthening 	<ul style="list-style-type: none"> • Investment finance • Technical assistance • Guarantee • Policy reform finance
Operational	Delays in administrative procedures	Medium	High	<ul style="list-style-type: none"> • Process optimization • Investment in infrastructure • Regulatory reforms • Institutional strengthening 	<ul style="list-style-type: none"> • Investment finance • Technical assistance • Policy reform finance
Type of risk	Source of risk	Probability of occurrence	Magnitude of impact	Mitigation action	Instrument
Operational	Insufficient input quantity or quality from suppliers	Medium	High	<ul style="list-style-type: none"> • Machinery modernization and maintenance • Adopt new technology • Improve processes • Technical training • Increase visibility and collaboration 	<ul style="list-style-type: none"> • Investment finance • Working capital finance • Technical assistance • Partnership incentives
Credit	Collateral uncertainty	Medium	High	<ul style="list-style-type: none"> • Regulatory reform • Institutional strengthening • Additional guarantees 	<ul style="list-style-type: none"> • Policy reform finance • Investment finance
Credit	Uncertainty regarding credit rating	Medium	High	<ul style="list-style-type: none"> • Regulatory reform • Institutional strengthening • Additional guarantees 	<ul style="list-style-type: none"> • Policy reform finance • Investment finance
Liquidity	Delay or interruption in payment cycle	Medium	High	<ul style="list-style-type: none"> • Increased liquidity 	<ul style="list-style-type: none"> • Credit funds • Guarantee funds
Liquidity	Financial instability of the enterprise	Medium	High	<ul style="list-style-type: none"> • Increased liquidity • Improve financial management capacities 	<ul style="list-style-type: none"> • Credit funds • Technical assistance

Source: Authors' elaboration.

Conclusions

This paper proposes an innovative approach to motivate businesses in the region to access and remain as participants in a value chain. Based on international experience, firms that participate in value chains tend to be more productive, resulting in the higher levels of economic growth. LAC enterprises, however, participate in value chains to a much lesser extent than in other regions. Firms cite the lack of access to finance as one among the challenges to higher participation in value chains, preventing them to invest and financially manage the productive cycle. In effect, market failures in the region's financial system have meant that finance for the productive sector is scarce, expensive, and short term. In this context, the public sector, through development banks and specialized agencies, has implemented a series of programs to encourage value chain finance. These programs focus on the various value chain links and needs, at the same time adopting some suitable instruments. The approach discussed in this paper builds on existing experiences and adopts a systemic perspective, based on current economic structure, to support the design of programs to overcome, in an integrated manner, the challenges and risks that may occur in a value chain.

Value chains within the modern industrial organization are increasingly complex due to growing interdependence and interconnection between actors and processes, thus generating high levels of uncertainty and risk. Risks are diverse and can arise from different sources. This paper has classified them into the categories of systemic, market, operational, credit, and liquidity. Risks are multiple and can be interconnected throughout the chain, in that a risk in one part of the chain can lead to risks in other parts. Consequently, while strategies to resolve a specific problem in a chain may certainly achieve partial success, they may be unable to do so at the global level. An integrated risk management strategy that includes all participating actors and the links in a chain is the key to optimal operation. The strategy should include the ability to identify the potential of risk, the source, the probability of occurrence and the magnitude of impact, and the appropriate methods of action to mitigate and reduce chain vulnerability. Public sector involvement is crucial in the design of integrated risk management strategies to prevent the failure of the private sector to collaborate and, therefore, to achieve optimal equilibrium. There are three reasons for such failure. The first is the absence of consideration of risk identification at the global chain level and in ways in which to prevent and mitigate threats. The second is that private sector actors within the chain aim to merely maximize local positions with little regard for the consequences at the global level, rather than coordinate themselves. The final reason is the restricted access to finance to enable the implementation of risk prevention and mitigation.

In the context of this growing complexity and the risks involved, this paper suggests a shift away from traditional programs that concentrate on lifting finance restrictions from a specific node in the chain to programs that aim to include access to finance in support of design and implementation of integrated risk management strategy. Access to finance is indispensable for implementing risk management across value chains, and given that risk can occur at different levels within the chain, it is essential to ensure that the participants in the chain are able to access finance. Alternatively, mitigation will be jeopardized, causing inefficiency and instability throughout the chain. Due to the

diverse nature of risk and its prevention, programs should aim to achieve a more appropriate combination of financial and nonfinancial instruments, overcoming the local, “one-size-fits-all” solution. Programs should support the evaluation of chain obstacles and solutions, and introduce public policy instruments that will contribute to global efficiencies and public sector cost-effectiveness.

The IDB, as a partner, is able to assist in the design of these programs and support the implementation of necessary actions and instruments. For example, in countries such as Argentina, the Dominican Republic, and Nicaragua, the IDB has supported program design that combines financial and nonfinancial instruments to improve integrated value chain risk management; contributed to forging strategic alliances with the private sector and within the public sector to make program implementation more viable; and leveraged its own resources and those of international donors for technical assistance and the expansion of long-term finance, among other actions. The IDB has a series of financial instruments available, such as investment loans; loans for policy reform; and guarantees and technical assistance resources that can be combined in various ways, according to a public-sector program context, the risks identified, and the strategy designed to mitigate them.

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