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TRADE INTERCONNECTEDNESS: THE WORLD WITH GLOBAL VALUE CHAINS

EXECUTIVE SUMMARY

Evidence based on the World Input-Output Database (WIOD), which became available in May 2012, shows that global value chains (GVCs) are creating more and more of world income, including labor income. This is by no means limited to manufacturing; indeed more income is generated by exporting services within GVCs. Moreover, the fragmentation of the production process across different countries has led to a strong trade-investment nexus. Data at the individual country level indicate that being part of GVCs is associated with a higher growth rate since the mid-1990s.

The emergence and growth of GVCs have important implications for the Fund's surveillance work, in particular on measuring competitiveness, or the real effective exchange rate (REER). The standard REER computed at the Fund is based on the assumption that goods traded are final goods only. Given that trade in intermediate goods is now more than two thirds of total trade, this may be problematic. For example, it does not account for the fact that a nominal appreciation not only makes goods more expensive to sell, but also makes intermediate inputs cheaper to import. One approach to account for GVCs is to modify the formula so that changes in intermediate inputs costs can be reflected in the REER. An alternative approach is to move away from a "goods" to "tasks" world and to measure the competitiveness in "tasks" rather than "goods". Empirical applications of these new approaches find that incorporating GVCs is complex, but provides new insights on competitiveness; for instance, trade weights matter but the choice of the price index seems to matter more. To fully operationalize these tools in the Fund's surveillance work, however, more work is needed.

The growth of GVCs has led to the rise of "supply-chain trade" which involves multidimensional cross-border flows of goods, investment, services, know-how, and people. Supply-chain trade is associated with a number of changes in trade policy-making. First, it reduces incentives for the use of traditional protectionist measures, though traditional trade restrictiveness measures still harm growth and resilience of GVCs. Second, behind-the-border measures and trade facilitation bottlenecks are becoming more important to GVCs than traditional trade policy measures. Third, new rules and disciplines underpinning the rise of supply-chain trade are being written into the "mega" Free Trade Agreements (FTAs), creating a risk of contributing to fragmenting the multilateral trading system.

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CONTENTS

INTRODUCTION	3
WHAT DO THE NEW DATA SAY ABOUT GLOBAL VALUE CHAINS (GVCS)?	6
A. Evolution of GVCs	6
B. GVCs and Growth	11
MEASURING COMPETITIVENESS IN THE WORLD WITH GVCS	15
A. Background	15
B. Incorporating GVCs in REER	16
C. Empirical Applications	21
D. Policy Implications	25
POLICY-MAKING IN THE WORLD WITH GVCS	26
A. Protectionism and GVCs	26
B. “Deep” Disciplines and GVCs	30
C. Policy Implications	31
BOXES	
1. Measuring Trade on Value-Added Basis	7
2. GVCs, Jobs, and Inequality	13
3. Trade Elasticity, Downturns, and GVCs	14
4. Value-Added Exchange Rate	19
5. Goods Real Effective Exchange Rate	20
6. Trade and Exchange Rate Volatility	29
References	33

INTRODUCTION

1. **The growth of trade relative to output in the last few decades is in large part driven by the emergence and growth of Global Value Chains (GVCs).** As a share of global output, trade is now more than four times its level in the early 1950s. Trade liberalization, which led to significantly lower trade barriers, and technology-led declines in transportation and communication costs facilitated the fragmentation of production beyond national borders. These developments led value or supply chains to become regional, as in the case of “Factory Asia” (Baldwin, 2008) or even global, as in the case of the iPod (Dedrick, Kraemer, and Linden, 2010). As a result, the foreign content share in gross exports on average has almost doubled since 1970. The increase in these shares has been particularly pronounced in emerging market economies that rely heavily on advanced economies for core sophisticated intermediate inputs for producing their exports.
2. **Trade in value-added has become a focus of policymakers for a number of reasons.**
 - a. **First, trade in value added can shed light on *trade imbalance disputes*.** A country’s overall trade surplus or deficit with the rest of the world (i.e., its global trade balance) is the same whether measured with gross trade flows or using value-added based measures. However, bilateral balances are better measured with value-added, rather than gross, trade data. Specifically, the use of gross trade data can exaggerate the importance of producing countries at the end of value chains, e.g., China (OECD-WTO, 2013).
 - b. **Second, trade in value added can better inform on the effects of exchange rate changes.** Changes in relative prices (including through exchange rate changes) would result in nonsymmetric rebalancing effects between downstream and upstream countries. For example, a higher foreign content share in the exports of a country can mitigate the impact of exchange rate changes compared to countries that do not rely on imported inputs as much. Similarly, the impact of a change in relative prices is also smaller for sectors with more reliance of GVCs.¹
 - c. **Third, GVCs contribute to explaining the transmission of macroeconomic shocks across countries (*trade spillovers*).** The 2008-2009 global financial crisis was characterized by a synchronized trade collapse in all economies, as a sharp decline in the demand for durable goods in advanced countries led to a strong contraction of exports of countries located downstream in the GVC. A better understanding of trade spillovers has become important to

¹ See Riad and others (2012). They used a partial equilibrium model with highly disaggregated product-level data and examined the impact of relative price changes on trade structures of four key players in global trade, namely China (downstream country), the Euro Area, Japan, and the United States (upstream countries). In addition to asymmetric adjustment, the paper found that adjustment in trade balances takes place more with trading partners outside of the value chains, as exports to value chain partners are more resilient to relative price changes.

macroeconomic policymakers than ever before. Greater focus on interconnectedness and spillovers analyses has been particularly important for the Fund.²

- d. **Fourth, trade in value added has direct implications for jobs and growth.** Outsourcing (i.e., buying inputs from outside sources rather than producing them internally), or offshoring (i.e., foreign outsourcing and FDI) are often indicated in the public debate as leading to losses of domestic jobs. While this may be true in one dimension, jobs are increasingly created as part of GVCs in other dimensions, as the internationalization of production is associated with higher productivity and an expansion of economic activity.
- e. **Fifth, trade in value added changes the notion of competitiveness.** A standard indicator to assess the competitiveness of a country is its Real Effective Exchange Rate (REER), which is conventionally based on gross trade flows and consumer price indexes. This is a useful indicator in a world where countries compete to sell goods and services that are produced using mostly domestic inputs, but it fails to measure competitiveness appropriately in a world where supply-chain trade is increasingly important. This has led to a debate on how to incorporate the effect of GVCs in measuring competitiveness.
- f. **Finally, value-added trade can also add insights to understand protectionism and the role of trade agreements.** Traditional ‘beggar thy neighbor’ trade policy can turn into ‘beggar thyself’ policy if countries are interconnected through GVCs. Recent research suggests that the growth in GVCs has played a significant role in limiting the use of traditional protectionist instruments (e.g., Gawande, Hoekman, and Cui, 2011). On the other hand, the fragmentation of production across borders creates new forms of policy spillovers and makes the distinction between trade and domestic policy blurred. These policy problems are complex to address in trade agreements.

3. The aim of this paper is to document the evolution of the GVCs since the mid-1990s and to address its implications for the Fund’s surveillance work. An earlier Fund Board paper (subsequently, reissued as a SPR Departmental Paper: Riad and others, 2012) covered implications of GVCs related to trade imbalances, rebalancing, and spillovers. This paper examines implications of GVCs for jobs and growth, competitiveness, and protectionism and trade-related policies. Existing evidence suggests that GVCs have contributed to productivity gains and growth. Most of these studies are, however, based on specific countries or micro-level data. Section 2 draws on the World Input-Output Database (WIOD),³ which covers 40 countries and 1995-2009, to document dynamics of (i) trade linkages between countries and regions through GVCs and its impact on the real

² One of the main findings of the *2011 Triennial Surveillance Review* (IMF, 2011b) was that “surveillance is still seen to be too fragmented, and its risk assessments lacking requisite depth and attention to interconnections and transmission channels.” Since then the Fund has put greater emphasis on interconnectedness and spillover analyses. The recent *Spillover Reports* (IMF, 2011c; IMF 2012) were a first step towards better understanding spillovers emanating from five systemic economies: China, the Euro Area, Japan, the United Kingdom, and the United States.

³ The world input-output tables were compiled by the WIOD project at the University of Groningen; see Timmer (2012) for contents, sources, and methods for this database.

economy and (ii) possible relationships between GVCs and growth. Data show that higher growth is associated with higher involvement with GVCs, measured in terms of growth as well as the level of value-added exports and imports.

4. Section 3 examines the implications for measuring competitiveness. In particular, it examines the REER, one of the most important tools used at the Fund for the bilateral as well as multilateral surveillance work. The standard formula used at the Fund is based on a theoretical foundation that assumes no trade in intermediate inputs. The analysis of the section shows a potential benefit of changing the way REERs are calculated at the Fund.

5. Section 4 focuses on policy making in the world with GVCs. The internationalization of production processes implies that cross-border flows of goods, investment, services, know-how, and people often complement each other. This fact opens new international policy coordination problems that go well beyond the negotiation of reciprocal market access concessions through the reduction of traditional border measures such as tariffs. Behind-the-border measures and domestic policies have become a more important barrier to supply-chain trade. For example, weak protection of intellectual property rights (IPR) and of investment rights has a negative impact on GVCs as firms' knowledge and capital have more international exposure. "Deep" FTAs often aim at coordinating these new policy problems by including disciplines on areas such as competition policy, IPR protection, investment, and movements of capital. The increasing importance of deep FTAs is, however, creating a potential risk of regulatory segmentation of the multilateral trading system and of exclusion or discrimination in trade relations.

6. This paper refers to a number of concepts that are closely related to GVCs and hence some clarifications are warranted at the beginning. For instance, *value chains* are often referred to as a chain of activities that a "firm" operating in a specific industry performs to deliver goods or services. An "industry" value chain includes various processes (often performed by networks of firms) that are involved in producing goods and services, for example, starting with the design of a product, moving onto the procurement of raw materials, and ending with the delivered product. The industry-level value chain, which is also known as the *supply chain*, is the main focus of this paper. GVCs, however, have become a commonly used acronym to describe both the firm and the industry-level value chains that span several countries. This paper also refers to various types of trade. *Value-added trade* (or trade in value added) is the value by country and industry that is added in producing goods and services for export (and import), where value added shares the same definition as the one used in the System of National Accounts (1993 SNA) (OECD-WTO, 2013).⁴ *Value-added exports* are value added produced in a country but is absorbed in another country (Johnson and Noguera, 2012). Finally, *supply-chain trade* (or GVCs trade) which is cross-border flows of goods, investment, services, know-how and people that are associated with GVCs (Baldwin and Lopez-Gonzalez, 2013).

⁴ Value added is hence equivalent to the difference between its output and the sum of its intermediate inputs of goods and services. It is also equivalent to the compensation for labor and capital (and taxes less subsidies).

WHAT DO THE NEW DATA SAY ABOUT GLOBAL VALUE CHAINS (GVCs)?

7. Evidence so far shows that GVCs have contributed to generating growth. The International Collaborative Initiative on Trade and Employment (ICITE), a joint initiative of 10 international organizations that was launched and coordinated by the Organisation for Economic Co-operation and Development (OECD),⁵ has surveyed and analyzed the impact of offshoring on jobs and growth (OECD, 2012). They conclude that “...imports may cause job displacement in the short-run, due to adjustment costs. ... In the long-run, there appears to be a positive relationship between imports and employment.” They also examine the effect of intermediate inputs trade on productivity and growth. They find that higher trade flows of intermediates are correlated with higher productivity. The Fund has also investigated how value-added trade especially in emerging Asia can help growth in Europe (Barkbu and others, 2012). This section revisits these findings covering a wider sample. It first reviews the evolution of GVCs in recent years and then focuses on their implication for growth.

A. Evolution of GVCs

8. Analyzing the role of GVCs is now feasible given the improvement in value-added trade data supported by a number of international organizations. Several papers, workshops, and international conferences hosted by OECD, WTO, and the World Bank have now addressed the issue of the measurement of trade flows in the context of the fragmentation of world production (Box 1). Input-output tables for selected countries and for the world are now available. Most recently, the first set of indicators of Trade in Value Added (TiVA) was released by the OECD and WTO on January 16, 2013 (OECD-WTO, 2013) and a comprehensive study followed (OECD, 2013).

⁵ Participating organizations include: Asian Development Bank (ADB), African Development Bank (AfDB), Economic Commission for Latin America and Caribbean (ECLAC), Inter-American Development Bank (IADB), International Labour Organization (ILO), Organization of American States (OAS), OECD, United Nations Conference on Trade and Development (UNCTAD), World Bank, and World Trade Organization (WTO).

Box 1. Measuring Trade on Value-Added Basis⁶

Measurement challenges. There is no internationally agreed methodological framework for measuring trade on a value-added basis, as international guidelines on measuring trade focus on gross values of goods and services. Further, it is not possible to measure trade on a value-added basis directly using official trade statistics. Official macroeconomic statistics compiled by national agencies are predicated on the concept of residence, and these statistics cover the activities of resident units (the national economy) with other resident units and/or between resident units and units in the rest of the world. For measuring trade on a value-added basis, the official statistics may provide some information on the domestic or import content of its exports, but it may not be possible to directly measure imported goods on a value-added basis, or to measure the domestic content of imports, even with data from trading partners or third economies.

Much of the work on developing measures of trade on a value-added basis has therefore focused on the use of international input-output tables, which have been constructed by combining the national input-output tables available from national statistical agencies. For example, the WIOD, covering 40 countries for the period 1995-2009, became available in May 2012. The Asian International Input-Output Tables, covering 10 countries for 1985, 1990, 1995, and 2000, are also available. The OECD Input-Output Database, covering 33 OECD member countries and 15 non-OECD member economies for years around 1995, 2000, and 2005, is often used together with the OECD Bilateral Trade Database to construct an international input-output table with a so-called proportionality assumption.¹

There are various challenges to the use of national input-output tables as part of a global framework. First, the national input-output tables vary widely in terms of the level of detail and scope, and are therefore not consistent. Second, the availability of national input-output tables for a broad cross-section of economies, particularly developing and emerging market economies, is limited. The development of input-output tables is a resource intensive exercise, a difficult undertaking on a regular and timely basis.

Current initiatives. The OECD, WTO, and the World Bank have promoted initiatives to support the development of statistics of trade on a value-added basis. In March 2012, the OECD and WTO announced a joint initiative to develop a database of Trade in Value Added indicators (TiVA) and to mainstream their production within the international statistics system. In January 2013, the agencies released preliminary results for 40 countries for 2005, 2008, and 2009. Future releases are expected to include broader country coverage and a longer time series.

There are other international initiatives being undertaken by research entities to measure trade in value added. These include the Global Trade Analysis Project (GTAP) at Purdue University and the Institute for Development Economics-Japan External Trade Organization (IDE-Jetro) project with the WTO. Furthermore, the Task Force on Global Production (TF), established by the Conference of European Statisticians in 2011, is charged with providing support for the effective implementation of BPM6 and 2008 SNA relating to global production. This TF is currently drafting a guide, and a chapter will be dedicated to Trade in Value Added.

The BPM6. The BPM6 now includes the transaction item, manufacturing services on physical inputs owned by others, which records the value of the processing activity undertaken by nonresidents that do not own the goods being processed. Thus, for goods that are processed for a fee by a nonresident, the value of processing is recorded separately in the accounts as a provision of services to the economy of the owner, and the gross values of the goods entering and leaving the processing economy are excluded from goods trade. This change in treatment increases the estimates of international services by the value of the processing services, and reduces the estimates of goods imports and exports by the value of the previously imputed trade flows in goods.

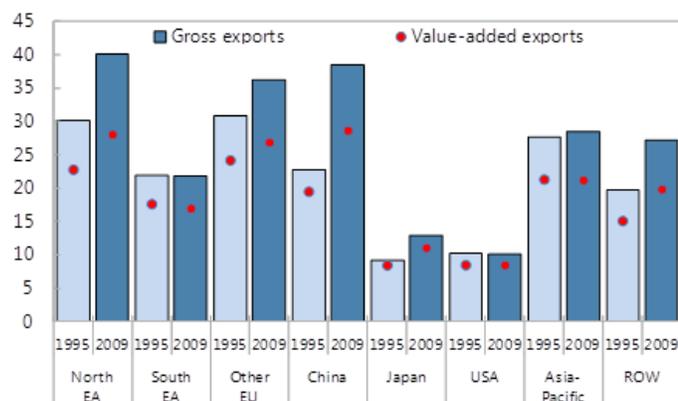
¹An assumption that final and intermediate goods trade patterns are proportional to gross trade patterns is required.

⁶ Prepared by Thomas F. Alexander (STA).

9. The growth of trade relative to output in the last two decades has been remarkable.

The world export-to-output ratio has grown from 20 to 25 percent during 1995-2009 (in 2008, the ratio was as high as 30 percent, before falling during the Great Recession). The change is even more remarkable for China and the northern Euro Area countries; the ratio of China has grown from 23 to 39 percent and that of northern Euro Area countries has grown from 30 to 40 percent.^{7,8} The growth in gross exports relative to output partly reflects the intensification of GVCs. That is, to produce the same amount of output, more intermediate inputs are crossing borders.

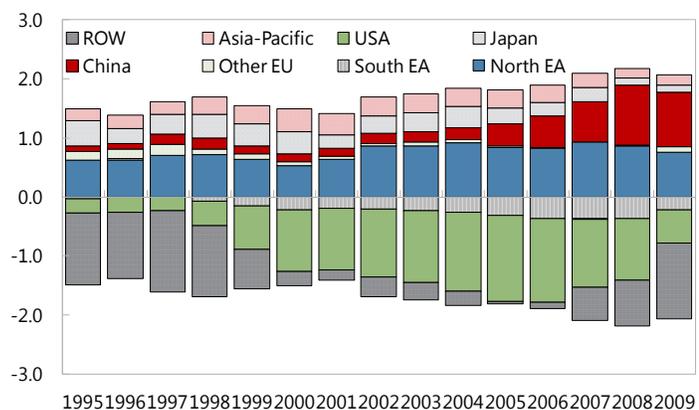
Gross- and Value-Added Exports
(percent of GDP)



Sources: WIOD, Fund staff estimates.

10. The impact of offshoring on domestic employment has been subject to political debate, but evidence indicates that the impact, even in the short term, is limited. Some argue that offshoring has been a cause of loss in domestic jobs. This argument may hold if net imports of value added are interpreted as replacing domestic value added, potential sources of income for domestic factors of production. In light of this, countries that are often blamed are net exporters. In fact, countries experiencing a rapid increase in net exports as a share of world output such as China (chart) have often been a target of trade frictions. Economic theory, however, provides little support to this view (Box 2). In presence of frictions in labor markets, an increase in offshoring to low-income countries can be associated with short-term unemployment for certain

Net Exports
(percent of world output)



Sources: WIOD, Fund staff estimates.

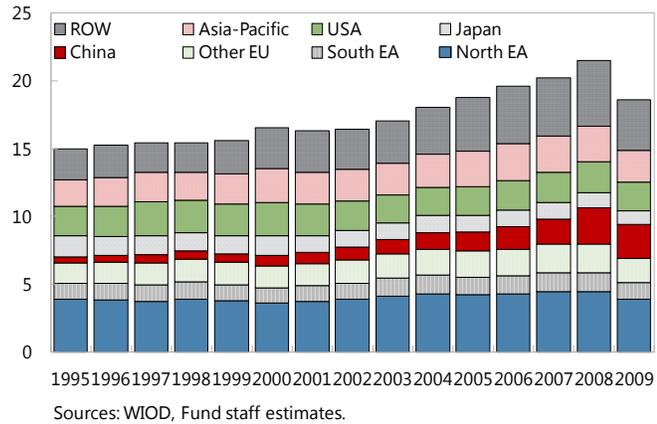
⁷ World net exports should be always zero, but data reported by individual countries do not necessarily sum to zero. In the WIOD, by construction, net exports of the world sum to zero.

⁸ In this section, 27 EU countries and 13 other major countries in the world (plus the rest of the world) in the WIOD are grouped into 8 countries and regions: the northern Euro Area countries (North EA) are Austria, Belgium, Estonia, Finland, France, Germany, Ireland, Luxembourg, the Netherlands, Slovakia, and Slovenia; the southern Euro Area countries (South EA) are Cyprus, Greece, Italy, Malta, Portugal, and Spain; other countries in the European Union (Other EU) are Bulgaria, Czech Republic, Denmark, Hungary, Lithuania, Latvia, Poland, Romania, Sweden, and the United Kingdom; Asia-Pacific countries are Australia, Canada, Indonesia, India, South Korea, Mexico, and Taiwan Province of China, and the rest of the world (ROW) are Brazil, Russia, Turkey, and other countries not listed above.

occupations (that require low-skills or less-complex tasks) in advanced economies. But empirical evidence shows that this effect (when positive) is economically small, though evidence for the impact of import competition, not limited to offshoring, on manufacturing employment tends to be much larger and increasing in the last two decades (e.g., Autor, Dorn, and Hanson, 2012).

11. It is also important to note that more income is generated by being part of GVCs. That is, value-added exports (or income generated by exporting) are becoming a bigger part of world income. Value-added exports (value added produced in a country and absorbed in another country) in the world have increased from 15 percent of world GDP in 1995 to 22 percent in 2008 before falling back to 19 percent in 2009.⁹ In fact, most countries (and all regions categorized in this paper) have increased contributions to world output though exporting. Contributions by emerging market countries have been particularly significant: value-added exports of China increased from 0.5 percent of world output in 1995 to 2.7 percent in 2008, and that of the rest of the world grouping (which includes many of the ASEAN countries) increased from 2.3 percent to 3.8 percent.

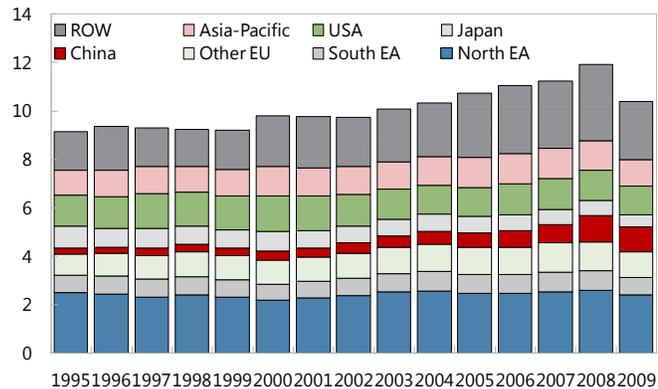
World Value-Added Exports
(percent of world output)



Sources: WIOD, Fund staff estimates.

12. The same is true for labor income. Labor intensity in production in general has fallen over time; labor income as a share of world output has fallen from 61 percent in 1995 to 58 percent in 2009. However, labor-income exports (that is, labor income generated by exporting) have increased over time; labor-income exports, which were 9 percent of world output in 1995, have increased to 12 percent in 2008. It is true that capital-income exports, which make up the rest of value-added exports, have increased faster from 6 to 10 percent of world output during the same period, implying that value-added exports have become more capital-intensive. The fact remains, however, that more labor income has been generated by being part of the GVCs.¹⁰

World Labor-Income Exports
(percent of world output)



Sources: WIOD, Fund staff estimates.

⁹ This trend sharply reverses during recessions (Box 3).

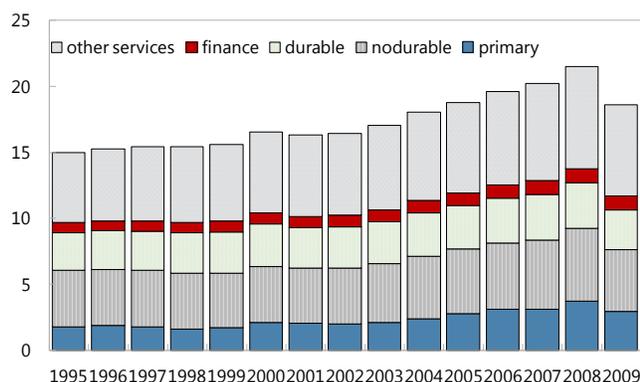
¹⁰ Timmer, Los, Stehrer, and de Vries (2012) go beyond labor income; they measure both income and jobs in a country that are directly and indirectly related to the production of manufacturing goods, called GVC income and

(continued)

13. It is not all about manufacturing; increasingly, income is generated by exporting services within GVCs. The reliance on supply-chain trade is generally thought of in the context of manufacturing goods production, especially durable goods. However, increasingly, selected tasks in services sectors (which are movable and hence susceptible to offshoring or outsourcing) are exported and have become a source of income. Income generated by exporting finance and other services has increased from 6 percent of world output in 1995 to almost 9 percent of world output in 2008.

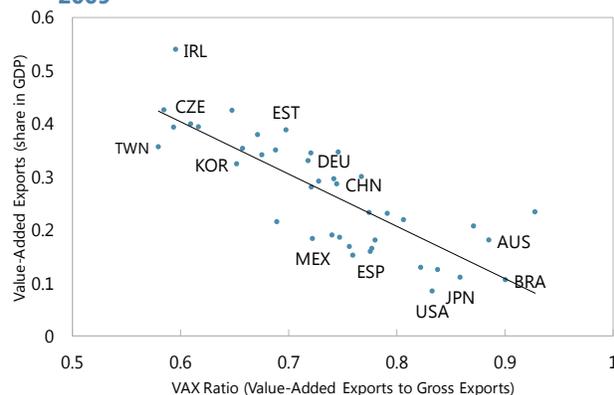
14. Being part of GVCs is not the only way to generate value-added exports, though measures of GVC participation and of value added-exports are highly correlated. The increase in value-added exports is determined by a number of factors. Both neoclassical trade theory, where countries specialize in sectors where they have a comparative advantage, and new trade theory, where firms with increasing returns to scale specialize in the production of a certain variety within a sector, contribute in explaining an increase in value-added exports. Being part of GVCs, or more precisely, participating in the assembly part of GVCs (by importing expensive inputs, adding relatively little domestic value added, and exporting goods with relatively higher foreign value-added content), however, seems to be highly correlated with higher value-added exports in GDP. For instance the chart shows the value-added exports as a share of GDP on the vertical axis and the ratio of value-added exports to gross exports, the VAX ratio (Johnson and Noguera, 2012), on the horizontal axis.¹¹ The VAX ratio tends to be low for countries participating in the assembly part of GVCs (e.g., emerging market economies) and high for countries providing “core” inputs (or largest value

World Value-Added Exports: by Sector
(percent of world output)



Sources: WIOD, Fund staff estimates.

Vertical Specialization and Value Added Exports: 2009



Sources: WIOD, Fund staff estimates.

jobs, since these activities are particularly prone to fragmentation. They find that fragmentation does not necessarily lead to destruction of jobs in advanced countries; the number of GVC jobs located in the manufacturing sector declined, but this was more than compensated for by GVC job creation in supporting services in most EU countries.

¹¹ There are many other measures developed to capture the role of value chains in exports: an import-content of exports (Hammels, Ishii and Yi, 2001), foreign value-added shares in exports (Koopman and others, 2010), vertical specialization of trade (Daudin, Riffart, Schweisguth, 2011), and imports to exports (I2E) (Baldwin and Lopez-Gonzalez, 2013).

added) of final products (e.g., advanced economies). The chart shows that countries focusing on the assembly part of GVCs (i.e., adding relatively low value added to final products) in fact generate a large proportion of their income from exporting.

B. GVCs and Growth

15. The link between trade and growth is not new. A main channel through which trade affects growth in incomes is by stimulating productivity. There are many ways through which trade can stimulate productivity that have been discussed in the literature (WTO, 2008). Trade can lead to productivity gains because it comes with investment that embodies technical improvements and creates knowledge spillovers. Trade can also lead to productivity gains by exporting (e.g., learning-by-exporting) as well as by importing (e.g., import competition driving out less productive firms/activities). It is also well-understood that trade policies matter, although the effect of trade policies on growth is hard to identify in macro data once other policies and country characteristics are controlled for.¹²

16. Data show that higher value-added exports, part of which result from participation in GVCs, are associated with higher growth rates. More specifically, staff examined the relationship between the growth of output and that of value-added trade (both exports and imports) and the level of value-added exports (relative to GDP), and compared it with the relationship found in gross trade data.^{13,14} Analysis based on the WIOD data (covering 40 countries) show that a country's growth in output (the part that is not explained by country-specific characteristics and time-specific events) is associated with growth of gross imports. This result can be interpreted as the growth in imports resulting in the growth of output, possibly through productivity gains generated by import competition. Data also show that growth (the part that is not explained by country-specific characteristics and time-specific events) has no relationship with the level of gross exports relative to GDP. A country's growth rate, however, is associated with more exporting and more importing of

¹² Rodriguez and Rodrik (2000) argued that indicators of "openness" were poor measures of trade barriers and were highly correlated with other sources of economic performance. They found little evidence for the link between trade policies and growth, once other relevant country characteristics were controlled for.

¹³ Conceptually, the "unbundling" of production has been shown to be equivalent to a technological improvement (Box 2). Some studies based on firm-level data have shown that higher trade flows of intermediates are correlated with higher productivity (Amiti and Konings, 2007; OECD, 2012). Using cross-country data would improve the country coverage, but the estimation method needs to address endogeneity issues pointed out in the trade policy and growth literature. Moreover, it is not clear what would be the most appropriate indicator to capture a country's level of integration in GVCs. The growth rate of value-added exports, that of value-added imports, and the level of value-added exports relative to GDP all capture some aspects of a country's involvement with GVCs. Staff addressed the first problem with a Fixed Effects (FE) estimator and the second concern by using various indicators of integration in GVCs.

¹⁴ The FE estimator takes care of endogeneity that arises from omitting heterogeneity that explains individual country's growth. There are two other important sources of endogeneity. One is a so-called period effect (some systematic shocks occur after a certain time period affecting both growth and exports). Including period dummies takes care of this problem. The other is simultaneity (i.e., a shock on country's output growth also triggers a change in the explanatory variables). The instrumental variable (IV) estimator would be ideal to deal with this problem. The simpler, though imperfect, solution used here is to consider lagged explanatory variables.

value added. While endogeneity problems can still be present, this evidence is consistent with the notion that trade contributes to growth, possibly through productivity gains from both export and import competition. Moreover, more rapid growth is associated with higher levels of value-added exports relative to GDP, the contribution of which increases as the VAX ratio increases (i.e., as a country moves up the value chain).¹⁵

Static Panel Data Analysis¹

Dependent Variable:	Sample Period: 1996-2008			
	output (growth)			
	(1)	(2)	(3)	(4)
gross exports (growth)	0.020			
gross imports (growth)	0.061**			
gross exports (relative to GDP) ²	-0.015			
value-added exports (growth)		0.041*	0.043*	0.045*
value-added imports (growth)		0.053**	0.049**	0.046*
value-added exports (relative to GDP) ²		0.115*	0.148**	-0.320*
VAX ratio			0.097	-0.242
value-added exports x VAX ratio				0.621**
R ²	0.417	0.422	0.424	0.431
No of countries	40	40	40	40
No of observations	533	533	533	533

Sources: WIOD, Fund staff estimates.

¹ The Fixed Effects (FE) estimator with period dummies is used. The explanatory variable is of previous period. ** and * denotes statistical significance at the 1- and 5-percent levels, respectively.

² Exports to GDP ratios are normalized to take values upto 1.

¹⁵ The contribution of the value-added exports (relative to GDP) on output growth is positive and increasing in the VAX ratio, as long as the VAX ratio is greater than 0.515 (=0.320/0.621), which is for most of the countries in the sample. Note also that the VAX ratio alone cannot contribute in explaining growth.

Box 2. GVCs, Jobs, and Inequality¹⁶

The internationalization of production contributes to raise firm productivity. In recent years, changes in technology have allowed different parts of the production process (sometimes referred to as tasks) to be performed in different countries. The possibility of reorganizing production across different borders and trading these tasks has relevant implications for firms' productivity. Conceptually, the "unbundling" of production has been shown to be equivalent to a technological improvement in a number of different models (Antras and Rossi-Hansberg, 2009). Empirically, recent studies support the existence of a productivity effect of offshoring (e.g., Amiti and Wei, 2009). However, "globalization" of production has also fueled popular fears that it will lead to higher unemployment and inequality, and lower wages, especially in advanced economies. This box reviews recent literature on the impact of GVCs on jobs and inequality.¹

GVCs increase aggregate employment through the reallocation of tasks across and within countries. The impact of GVCs on employment results from a complex array of channels (Görg, 2012). First, as trade in tasks increases the productivity of the offshoring firm, it leads to an expansion of sales that creates employment. Second, as a result of offshoring, firms can offer intermediate and final goods at lower prices. This implies that employment may grow through an expansion of activity of other businesses that can acquire cheaper inputs or through an increase in demand of final consumers that see their real incomes surge. However, while contributing to higher productivity and employment in the aggregate and over the long-term, the emergence of GVCs has also contributed to a global reallocation of jobs. Labor intensive manufacturing jobs in particular have moved from advanced economies to developing countries with lower labor costs, especially in East Asia (World Bank, 2012). Moreover, GVCs redefine the comparative advantage of countries across tasks rather than industries, leading to reallocation of jobs within countries across different occupations (Grossman and Rossi-Hansberg, 2008).

GVCs can be associated with short-term unemployment for certain types of workers, but these effects tend to be small. Reallocation of jobs across and within countries takes time and especially low-skilled workers or workers with industry or occupation specific skills are likely to face significant adjustment costs in the short-term. In the presence of frictions in labor markets, the process of reallocation can lead to short-term unemployment in certain industries or occupations, even if aggregate employment is not reduced. Recent studies exploit industry-level data (e.g., Amiti and Wei, 2005; Crino, 2010) and worker-level data (e.g., Ebenstein and others, 2009; Liu and Trefler, 2008) to identify these effects. Results show that an increase in offshoring to low-income countries can increase short-term unemployment for certain occupations in advanced economies, but this effect (when positive) is economically very small.³ These studies also find that the adverse employment effect of offshoring is stronger for low-skill workers and for workers specializing in less complex tasks, as these occupations are more easily tradable.

While not the key cause of raising inequality, value chains affect the distribution of income within countries. The expansion of GVCs since the 1980s has coincided with a significant increase in within-country income inequality in a number of advanced and developing economies.² This association has stimulated a wide debate on the longer term impact of GVCs (and of trade in general) on the distribution of income. Most economists agree that skill-biased technical change, not globalization, has been the dominant force driving the growth of within-country inequality (Katz and Autor, 1999; IMF, 2007; Jaumotte, Lall and Papageorgiou (2012)). Nevertheless, some studies point to offshoring as a possible contributing factor (Pavcnik, 2012). Specifically, offshoring can affect inequality by increasing relative demand for high-skilled workers both in developed and in developing countries (Hanson and Feenstra, 1996, 1997, 1999), by reducing job opportunities for workers in advanced economies whose occupations are more easily offshored to low-wage countries (Ebestain and others, 2009), and by increasing wages of workers in firms that offshore relatively to workers in firms that source domestically (Amiti and Davis, 2012; Hummels and others, 2011).

¹ The literature is large. The focus in this box is on the dimensions of GVCs, jobs, and inclusive growth that are most relevant for macroeconomics. See OECD (2012) and World Bank (2012) for broader literature surveys.

² See Autor, Katz, and Kearney (2008) and Goldberg and Pavcnik (2007).

³ In contrast, Autor, Dorn, and Hanson (2012) find that import competition from China had a substantial and increasingly large impact on manufacturing employment in the United States in the last two decades.

¹⁶ Prepared by Michele Ruta and Jarkko Turunen.

Box 3. Trade Elasticity, Downturns, and GVCs¹⁷

Value-added exports as a percentage of world output fell in 2001 and again in 2009. These oscillations coincided with periods where trade fell relatively more than demand. The WIOD can shed light on the responsiveness of trade relative to output during recessions.

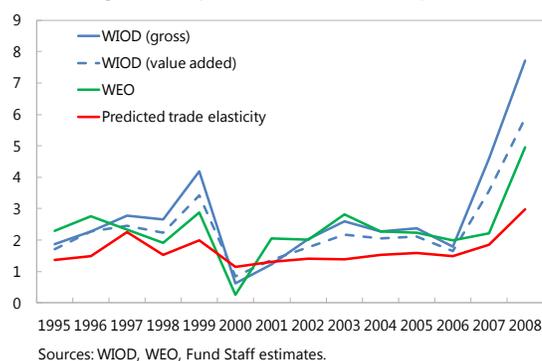
The responsiveness of trade flows to changes in demand tends to increase during global slowdowns relative to tranquil times. Trade flows have always been two to three times more volatile than GDP (Houthakker and Magee, 1969) and the volatility has been rising over time (Irwing, 2002), despite the fact that standard theories predicted an elasticity of one. Moreover, the responsiveness of trade flows to changes in demand seems to increase further during recessions (Freund, 2009).

There are a number of possible explanations (Freund, 2009). First, in recessions firms may draw down inventories to keep up with production while suspending new purchases of inputs including those from abroad. Second, protectionist policies tend to rise in a downturn, which exacerbates the decline in trade.¹ Third, goods trade declines by more than services trade during downturns, and services make up the bulk of GDP, while goods make up the bulk of trade. In 2008, the decline in durables was notable. Fourth, a large decline in trade could reflect a much smaller decline in the value added if production is done across countries at the margin, and as demand falls international production chains break down.² Fifth, firms and consumers may source more from home country suppliers during downturns because of trust or financing problems.

Staff explored the relative importance of some of these conjectures using WIOD. The impact on trade of asymmetric demand shocks, such as a sharper decline in one sector vis-à-vis another (e.g., manufacturing vis-à-vis services, durables vis-à-vis nondurables, or investment -including inventories- vis-à-vis consumption), can be examined using the WIOD. Trade elasticities (measured as the real change of world exports relative to that of world output) in the chart show a sharp increase in 2008, though the magnitude varies across different data. The red line shows “predicted” trade elasticity, where trade patterns are predicted using the multi-market model (Tokutsu, 2002) and the actual growth rate in domestic demand of all countries and sectors computed using previous- and current-year-price tables of the WIOD. That is, the “predicted” trade elasticity incorporates asymmetric demand shocks observed during recessions. In normal times, on average the predicted trade elasticity is about 1½. During the 2008-09 crisis, however, the predicted trade elasticity increased to about 3. This implies that the asymmetric shocks observed during the crisis, in particular the sharp decline in durables, can explain only part of the decline in trade observed, leaving the rest to be explained by other factors such as financing problems and a rise in costs of exporting and importing.^{3,4}

Trade Elasticity

(real change in world exports relative to that in world output)



Implications for Spillover Analysis. The Fund’s macroeconomic models typically focus on aggregate variables such as a shock to domestic demand. Monitoring the sectoral breakdown of domestic demand shocks would be beneficial, given the importance of the composition of shocks in determining the extent of trade spillovers. Having said that more work is needed on other factors resulting in higher trade elasticities during recessions.

¹ The use of these measures however seems to have been limited in during 2008-09 (see Section 4).

² The broad conclusion from the literature on the 2008-09 trade collapse is however that GVCs did not contribute significantly. Both Levchenko Lewis and Tesar (2010) and Bems, Johnson and Yi (2011) explore the possibility that GVCs contributed to the trade collapse, but do not find support for this channel. Furthermore, Bems, Johnson and Yi (2011) argue that GVCs likely alleviated the trade collapse.

³ Lack of comprehensive trade finance data at the onset of the 2008-09 crisis made assessing the role of trade finance in the collapse of trade difficult (Asmundson and others, 2011). More recent studies show that costs of exporting and importing sharply increased especially in sectors affected most by trade finance (Ahn, Amity, and Weinstein, 2011).

⁴ Other studies using different models and data (Bems, Johnson, and Yi, 2011; Eaton and others, 2011) show up to 70 to 80 percent of the trade collapse can be explained by demand shocks, leaving a smaller fraction to be explained by other factors.

¹⁷ Prepared by Mika Saito.

MEASURING COMPETITIVENESS IN THE WORLD WITH GVCS

A. Background

17. Work on incorporating GVCs in measuring competitiveness has begun at the Fund in recent years. Patterns in global trade are different when measured based on value-added trade versus gross trade as shown in the earlier section (see also Riad and others, 2012). This matters in particular for countries that use a significant amount of imported intermediate goods to produce exports, such as China and many other emerging market economies. However, standard measures of REERs rely on consumer prices (CPI) and on gross trade data to evaluate international competitiveness (see Bayoumi, Lee, and Jayanthi, 2005 for the standard methodology that is used to compute REERs at the Fund). This raises the question whether REERs based on value-added data can provide more accurate measures of changes in competitiveness.

18. Standard CPI-based REERs computed at the Fund are based on the assumption that goods traded are final (consumption) goods only. The formula currently used at the Fund to compute the standard REER indices faces a number of limitations. First, it does not account for trade in intermediate goods. For example, it does not account for the fact that a trading partner's nominal depreciation could boost competitiveness through cheaper imported inputs. Second, the CPI is not well suited to the question of competitiveness: it does not include prices of exports and includes prices of imports. Third, there is no information on the relative price of nontradables to tradables (real exchange rate).

19. Modifying price indices or comparing REERs with different price indexes is not new. Lipschitz and McDonald (1992) and, more recently, Bayoumi, Harmsen, and Turunen (2011) and Ángel, Galí, and López-Salido (2012) showed that different proxies for goods prices (CPI, GDP deflator, and unit labor cost (ULC)) can provide different information. It is well understood that REERs with GDP deflators (or ULCs) that reflect differences in domestic costs of production can deviate significantly from the standard REER. Fund desks are encouraged to look at different measures of REERs to assess competitiveness in their bilateral surveillance work.¹⁸ Such a comparison has been a standard practice especially for desks working on countries in Europe, given the availability of Eurostat indicators for different measures of REERs.

20. Incorporating the effect of GVCs is, however, relatively new. With the emergence of and the growing importance of the role of GVCs, a number of modifications have been studied at the Fund. There are two approaches. One is to move away from a “goods” world to a “value-added” world, given that value-added as opposed to gross trade ultimately matters for competitiveness. The other is to modify the prices of goods within a “goods” world to reflect the use of intermediate inputs.

¹⁸ The Fund publishes, through the International Financial Statistics, several indicators.

21. This section summarizes what has been done to incorporate the effect of GVCs in measuring competitiveness and compares new measures with the standard measure. Section B summarizes the two alternative approaches. Section C compares the REER measures computed using alternative methods. Section D discusses policy implications.

B. Incorporating GVCs in REER

22. The theoretical foundation for the standard formula used at the Fund is based on the model of consumer demand. Original work by Armington (1969) and McGuirk (1987) and subsequent work done by Zanetto and Desruelle (1997) and Bayoumi, Lee, and Jayanthi (2005) assume that goods produced in different countries are different and individuals who have taste for variety make consumption decisions based on relative prices of those goods and their budget constraints. Moreover, the model assumes that goods are produced solely with domestic factors of production (labor and capital) and there are no intermediate inputs traded across countries. Demand equations are aggregated over goods and markets to derive the standard formula used at the Fund: country j 's real effective exchange rate is measured by

$$REER_j^{Standard} = \prod_{k \neq j} \left(\frac{P_j R_j}{P_k R_k} \right)^{w_{jk}},$$

where P_j and P_k are prices that the consumer faces (e.g., CPI), R_j and R_k are respective nominal exchange rates and w_{jk} is the gross trade weight that captures import competition (i.e., competition in country j), export competition (i.e., competition in trading partner country k) and the third market competition (i.e., competition between j and k in all other markets). As discussed above, this measure fails to properly capture competitiveness in a world with GVCs.

23. One approach is to move away from a “goods” to “value-added” world and to measure the competitiveness in “factors” rather than “goods.” Bems and Johnson (2012) argue that the REER should reveal the competitiveness of “tasks” traded as part of goods and not of the goods themselves (Box 4).¹⁹ They show that when the same functional form that describes consumer preferences is assumed to describe production technology, the Fund’s standard REER formula can be used in measuring the Value-Added Real Effective Exchange Rate (VAREER). Given that it is “tasks” that are traded as part of goods, however, weights and prices need to reflect “tasks” rather than “goods.” That is, the weights need to reflect value-added trade patterns, and prices should be the price of production factors:

$$REER_j^{Tasks} = \prod_{k \neq j} \left(\frac{q_j R_j}{q_k R_k} \right)^{v_{jk}},$$

¹⁹ They model intermediate input demand as well as that of consumption (or final) demand. That is, a producer in country j minimizes the cost of production subject to gross production technology and chooses the level of intermediate input (differentiated by country). Intermediate and final demand equations are aggregated over goods and markets to derive a formula for the REER.

where q_j and q_k are prices of production factors, proxied by GDP deflators, though strictly speaking the GDP deflators would not only reflect the cost of factors but also economic profits.²⁰ Weights v_{jk} are the weights based on value-added trade patterns. Note that, unlike the standard trade weights that reflect relative size of transactions between countries, the new weights reflect relative size of value-added, embodied in goods movement across countries.

24. Revisions to the trade weights, however, make little difference empirically. Revisions could be needed as GVCs can redefine a country's competitors. In particular, as there is less competition between countries joined in a value chain, the VAREER assigns smaller weights to countries that share a value chain. For example, the VAREER for the United States puts a smaller weight on NAFTA partners than the traditional REER. Similarly, Korea is assigned a relatively smaller weight in the VAREER for China. Because of a low correlation between relative price movements and revisions to the trade weights from gross to value-added trade, however, revisions to these weights matter little empirically. Thus, a proxy for the VAREER can be constructed using the standard REER formula with the GDP deflator replacing CPI.

25. An alternative approach within a "goods" world is to modify the formula so that the changes in the cost of intermediate inputs can be reflected in the REER. The Asia Pacific Regional Economic Outlook April 2011 (IMF, 2011a) and Untererberdoerster, Mohammed, and Vichyanond (2011) computed for a number of East Asian economies a so-called Integrated Effective Exchange Rate (IEER), which accounts for changes in the prices of imported intermediate inputs that are embodied in final goods.²¹ In the same spirit, Bayoumi, Saito, and Turunen (2013) derive a formula for the Goods Real Effective Exchange Rate (GOREER) which also has two parts, one measuring competition over domestic value-added content of Country j 's goods (DVA_j) vis-à-vis those in Countries k 's goods (DVA_k) and the other measuring competition of foreign value-added content of Country j 's goods (FVA_j) vis-à-vis those in Countries k 's goods (FVA_k):

$$REER_j^{Goods} = \prod_{k \neq j} \left(\frac{q_j R_j}{q_k R_k} \right)^{w_{jk}} \prod_{k \neq j} \left(\frac{q_j R_j}{q_k R_k} \right)^{\omega_{jk}},$$

where ω_{jk} captures relative importance of FVA_j vis-à-vis DVA_j as well as relative importance among source countries comprising FVA_j (Box 5). By incorporating the competition over foreign value-added content, the GOREER can account for the fact that a nominal appreciation for example not only makes goods more expensive to sell, but also makes foreign production factors cheaper to import. Compared to the standard REER with no production sharing, therefore, relative prices of goods can appreciate by less than an increase in the underlying relative cost of production.

26. There are pros and cons to both the GOREER and VAREER. VAREERs or a proxy for VAREERs are parsimonious and better-suited theoretically for measuring competitiveness of a country's factors of production (i.e., labor and capital), value-added exports, or any other value-

²⁰ Transfer pricing by large global conglomerates (i.e., the allocation of profits among controlled firms in different jurisdictions) can also be affecting allocations of value added across countries.

²¹ The IEER is based on work by Thorbecke (2011).

added variable including net exports.²² Empirical applications include forecasting of value-added trade patterns, net exports, and assessing a country's long-term cost competitiveness. VAREERs, however, may not be optimal for examining goods trade patterns themselves. GOREERs are better-suited for measuring price competitiveness of gross output, gross trade, or any other 'gross' flows (exports and imports). Empirical applications include forecasting of gross trade patterns and assessing competitiveness of a country's goods exports or imports. GOREERs do not say anything about value-added trade patterns directly, but by pinning down goods trade patterns, they can imply value added embedded in those goods trade patterns. Empirical results below suggest that the distinction between the GOREER and VAREER is more relevant for countries with a larger reliance on GVCs such as emerging market economies.

²² Net exports are included since exports and imports are gross variables but the difference of the two (i.e., net exports) is a value-added variable. Net exports in fact can be calculated either by subtracting gross imports from gross exports or (if data are available) by subtracting value-added imports from value-added exports net exports.

Box 4. Value-Added Exchange Rate²³

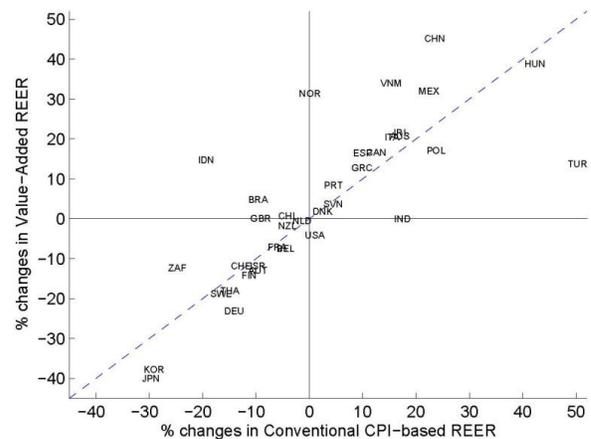
REERs are widely used to gauge competitiveness. Yet conventional REERs, based on gross trade flows and consumer price indexes (CPIs), are not well suited to that role when imports are used to produce exports – i.e., with vertical specialization in trade. The problem is that the conventional REER is based on an outdated assumption that countries compete against each other to sell ‘products’ that they produce entirely at home, using domestic inputs only.

The iPhone’s supply chain. To illustrate this problem, consider the iPhone. The conventional approach classifies the iPhone as China’s ‘product’, and supposes that China competes against other suppliers of smart phones. In reality, China is the final assembly point for the iPhone, one link in a production chain spread over many countries. Accounting for the supply chain redefines the China’s ‘product’ to be the fragment of iPhone’s value added actually produced in China, i.e., assembly services. The supply chain also redefines China’s competitors. There is less competition between countries that share a supply chain because each can affect the final price of the iPhone and hence the competitiveness standing of any other partner in the supply chain. For example, a nominal depreciation of a supply chain partner’s currency, by lowering the price of imported input components, can decrease the final price of the iPhone, boosting its final sales and thus also exports of China’s assembly services. This channel is entirely absent from the conventional approach to REER, where a depreciation in a competing country necessarily implies a loss of competitiveness for China.

The iPhone example points to a general idea that REER should be measuring how demand for a country’s value added (i.e., the assembly services for China) responds to changes in the price of value added (i.e., cost of labor and capital in China). Furthermore, the REER should take into account the changed nature of competition (i.e., China competes less with its supply chain partners in Asia than simple gross trade numbers would suggest).

Value-Added REER (VAREER). Bems and Johnson (2012) extend the conventional REER framework to include vertical specialization in trade and apply the framework to construct a VAREER for 42 countries over the 1970-2009 period. The VAREER uses (i) GDP deflators to measure changes in relative prices, because they are the most direct summary measure for factor (capital and labor) costs and (ii) bilateral trade in value added to construct country trade weights. The authors show that such trade weights capture the changed nature of competition resulting from the rise of supply chains. For example, by down weighting a supply chain partner, the new trade weights allow for the fact that competitiveness may be boosted by depreciation in a country from which intermediate inputs are imported.

While changes in VAREER are strongly correlated with changes in the conventional REER, substantial differences can emerge between the two, especially over longer periods. The figure compares changes in the conventional REER, during 1995-2009, on the horizontal axis and changes in the VAREER on the vertical axis. Points off the 45-degree line indicate deviations between the VAREER and conventional REER. Larger differences are observed for Brazil, China, India, Indonesia, Japan, Korea, South Africa, Turkey and Vietnam, implying that for those countries, the accuracy of conventional REER in measuring competitiveness may have been particularly questionable.



Conclusions. The new index takes global value chains into account in assessing competitiveness. It is therefore likely to give a more accurate picture than conventional REER measures. Because it is possible to construct a new VAREER from existing data, Fund desks and policymakers interested in improving their understanding of competitiveness might well consider including it in their toolbox.

²³ Prepared by Rudolfs Bems (RES).

Box 5. Goods Real Effective Exchange Rate²⁴

A simple 2-country, 2-good and 1-production factor example demonstrates the intuition behind the GOREER approach. Suppose that the prices of goods produced in Country 1 (domestic) and Country 2 are P_1 and P_2 , respectively, R_1 and R_2 are the nominal exchange rates, and the costs of production factors in Countries 1 and 2 are q_1 and q_2 , respectively. Suppose that q_1 and q_2 can be proxied by the GDP deflators. *Production sharing* implies that both countries import intermediate inputs from each other. As a result, factors of production (or value added) of both countries become embedded in both goods. Suppose that δ_1 is the share of domestic value added in production in country 1 (and, hence, $1 - \delta_1$ is the share of foreign value added in the domestic economy) and δ_2 the share of domestic value added in production in country 2. Under some simplifying assumptions,¹ the prices of goods P_1 and P_2 in a common currency can be expressed as follows:

$$\begin{aligned} P_1 R_1 &= (q_1 R_1)^{\delta_1} (q_2 R_2)^{1-\delta_1}, \\ P_2 R_2 &= (q_1 R_1)^{1-\delta_2} (q_2 R_2)^{\delta_2}. \end{aligned}$$

In this case, the real effective exchange rate (REER) can be expressed as follows:

$$REER_1 = \frac{P_1 R_1}{P_2 R_2} = \left(\frac{q_1 R_1}{q_2 R_2} \right)^{\delta_1 + \delta_2 - 1}.$$

- When there is no production sharing (i.e., $\delta_1 = \delta_2 = 1$), an appreciation of the REER (i.e., an increase in the relative price of goods produced in Country 1) would fully reflect an increase in either relative factor costs $\left(\frac{q_1}{q_2}\right)$ or in the nominal exchange rate $\left(\frac{R_1}{R_2}\right)$. That is, a 1 percent appreciation of the nominal exchange rate or relative increase in domestic costs would appreciate REER by 1 percent.
- When there is production sharing, however, the REER does not necessarily appreciate at the same rate as the increase in relative factor costs expressed in a common currency. For example, if domestic value-added shares were 0.84 and 0.74, respectively, a 1 percent appreciation of the nominal exchange rate would appreciate the REER only by 0.58 percent.
- The divergence between the rate of appreciation of the REER and the rate of increase in the underlying relative costs is greater, the greater the degree of production sharing.

In a multiple-country case, suppose that Country j 's goods would contain domestic value added and value added of all foreign countries i and compete with all foreign countries k . The GOREER formula comprises two parts, one measuring competition over domestic value-added content of Country j 's goods vis-à-vis those in Countries k 's goods (the first product sum) and the other that of foreign value-added content of Country j 's goods vis-à-vis those in Countries k 's goods:

$$REER_j^{Goods} = \prod_{k \neq j} \left(\frac{q_j R_j}{q_k R_k} \right)^{w_{jk}} \prod_{k \neq j} \left(\frac{c_j \prod_{i \neq j} \left(\frac{q_i R_i}{q_i R_i} \right)^{-\varphi_{ij}(1-\delta_j)}}{c_k \prod_{i \neq k} \left(\frac{q_i R_i}{q_i R_i} \right)^{-\varphi_{ik}(1-\delta_k)}} \right)^{w_{jk}},$$

where $\varphi_{ij}(1 - \delta_j)$ is the foreign country i 's value-added cost share in total cost of production in country j .

Conclusions. With production sharing, changes in relative prices of goods have become less sensitive to changes in relative factor prices or nominal exchange rates. The GOREER is constructed so that prices of goods reflect costs of all production factors (domestic and foreign) that are embedded in goods. Empirical investigation shows that being part of GVCs seems to have helped many emerging market economies retain goods competitiveness while losing competitiveness due to a relative rise in domestic factor costs.

¹ A Cobb-Douglas function is assumed to describe technology, and the average cost is set equal to the price of goods.

²⁴ Prepared by Mika Saito and Jarkko Turunen.

C. Empirical Applications

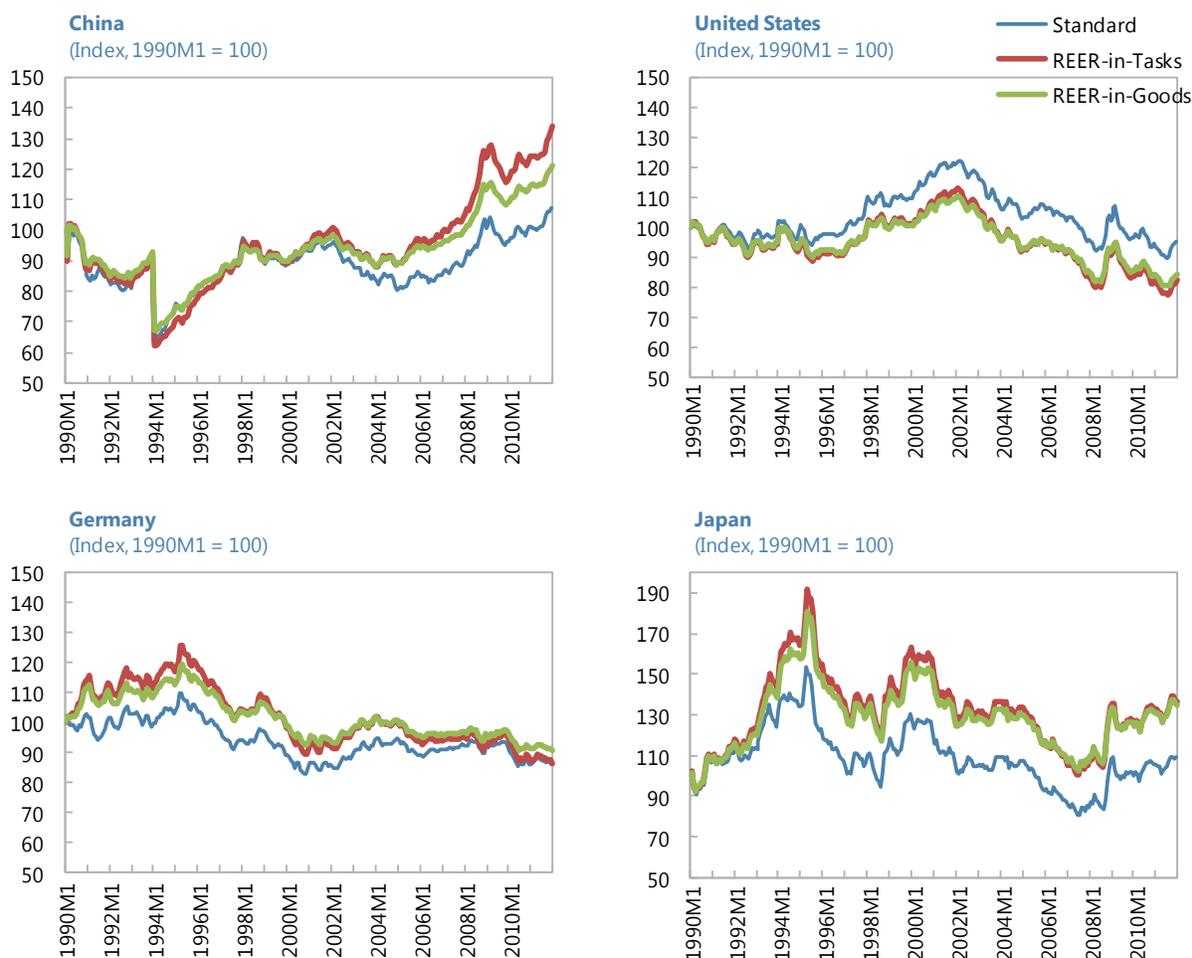
27. This section provides a first attempt to investigate the empirical relevance of the differences between the standard REER and the alternative measures discussed in the earlier Section. However, to fully operationalize these tools in the Fund's bilateral as well as multilateral surveillance work, more empirical analysis and case-studies are needed in coming years. Having said that, this section already shows that incorporating GVCs in measuring the REER can be a beneficial addition to the surveillance work.

28. The empirical relevance of new measures is investigated by comparing the standard REER, and a so-called REER-in-Tasks and REER-in-Goods. Differences are illustrated for selected countries in the chart below. Each panel shows three lines: (i) the *standard* REER, (ii) REER measuring competitiveness of "tasks" traded (referred to as *REER-in-Tasks* hereafter), and (iii) REER measuring competitiveness of goods traded but with an adjustment for imported intermediates (which is equivalent to the GOREER in the earlier section and is referred to as *REER-in-Goods* hereafter) for the period between 1995M1 and 2012M12.²⁵ Standard weights and value-added trade weights are computed for a sample of 42 countries where input-output tables are available. It is important to note that REER-in-Tasks is only an approximation of the VAREER of Bems and Johnson (2012). One of the main differences between the two measures is that the weights in the REER-in-Tasks change only three times, as in the standard REER (i.e., mid-1990s, early 2000s, and mid-2000s), while value-added trade weights in VAREER change every year.

29. Differences between the standard REER and the new indices incorporating GVCs are significant. For China and Japan both REER-in-Tasks and REER-in-Goods suggest more appreciation over time than the standard REER. For China the difference emerges from the early 2000s onwards, reflecting a gradual increase in domestic production costs, whereas for Japan the difference emerges in the early 1990s narrowing somewhat in the early 2000s. In cumulative terms, REER-in-Tasks suggests an additional 27 percent appreciation (relative to what is revealed in the standard REER) for both countries. For the United States, REER-in-Tasks suggests a gradual improvement in competitiveness over time (about 15 percent in cumulative terms) compared to the standard REER. For Germany, the compression in domestic labor costs has contributed to a decline in REER-in-Tasks from the mid 1990s onwards. REER-in-Goods reveals similar movements for all except for China where REER-in-Goods suggests a smaller appreciation (14 percent) instead.

²⁵ GDP deflator data (taken from the WEO or the IFS) are mainly quarterly thus have been intrapolated to generate monthly data.

A Comparison between Standard REER and Two Alternatives



Source: OECD, Fund staff estimates.

30. Most of these differences come from using different price indices, not weights. The difference comprises those in weights (i.e., gross versus value-added trade weights) and prices (CPI versus GDP deflator). As in Bems and Johnson (2012), most of the difference comes from using different price indices. Differences in gross trade versus value-added trade based weights are small. Comparing weights for the latest time period (mid-2005) shows that the average decline/increase is about one tenth of a percentage point. The largest decline is just below 3 percentage points and the largest increase is about 5 percentage points.²⁶ Given the significant growth in GVCs over time, this result seems counterintuitive. The simplest explanation is that the reduced role of domestic value added in exports affects exports to all destinations equally, leaving the relative importance of trading partners unaffected. Bems and Johnson (2012) provide an alternative explanation that the pattern of revisions to weights is not correlated with the pattern of cross-country differences in rates

²⁶ The magnitude of the differences in the standard weights and value-added trade weights is somewhat larger, but still small, in Bems and Johnson (2012).

of change of exchange rates or prices, leaving the net combined effects of revisions to trade weights almost negligible.

31. Differences between the rate of change in relative prices of goods and that in underlying relative costs are typically small but not so for many emerging market economies.

Differences between the rate of change in relative prices of goods (reflected in GOREER or REER-in-Goods) and that in relative factor prices (reflected in REER-in-Tasks) are typically small. For the United States, Japan, and Germany the two series are nearly identical.²⁷ However, for China REER-in-Goods suggests lower appreciation than REER-in-Tasks. This implies that a relative increase in domestic factor costs in China has not been translated into an equivalent increase in the relative price of Chinese goods. In cumulative terms since 1990, REER-in-Tasks reveals an appreciation of factor costs by 34 percent, a substantial difference from what is revealed in the standard REER, an appreciation of relative goods prices of 7 percent. REER-in-Goods indicates that an appreciation of relative prices of goods of 21 percent.

32. Cumulative differences between the standard REER and the new indices incorporating GVCs are observed for a wide range of countries.

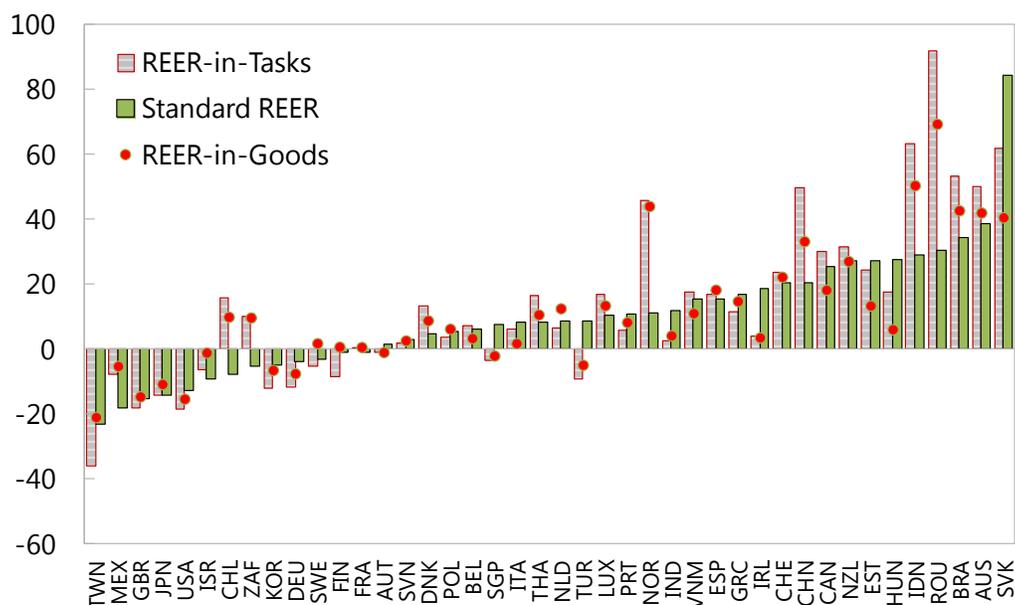
Cumulative differences between standard REER and REER-in-Tasks are especially large for countries that have gone through a rapid increase in GDP deflator relative to CPI during the sample period. Moreover, largest cumulative differences between REER-in-Tasks and REER-in-Goods are observed among emerging market economies in Europe (e.g., Estonia, Hungary, Romania and Slovak Republic) and those in Asia (e.g., China and Vietnam). For these countries, participation in GVCs has helped offset the impact of an increase in domestic costs, maintaining their competitiveness. While magnitudes are smaller, the reverse is true for many advanced economies that are well integrated in GVCs: their competitiveness has been eroded by the increasing cost of imported production factors from emerging market economies.²⁸ Overall, both appreciations and depreciations tend to be mitigated when the use of outsourcing is taken into account. There are, however, countries where losses in competitiveness owing to a relative increase in domestic costs are made worse by losses also in competitiveness of foreign value-added content (e.g., Greece, the Netherlands, Portugal, and Spain). This reveals that gains from having foreign-value added content (by mitigating the impact of a rise in domestic factor costs) have been small in these countries relative to similar gains observed in their trading partners.

²⁷ The direction of adjustment for the last few years is consistent with results shown in Unterberdoerster, Mohammed, and Vichyanond (2011).

²⁸ Note that this apparent loss owing to outsourcing refers to changes in relative prices over time, not to the level of relative prices. Owing to large remaining level differences in costs, it is likely that outsourcing continues to contribute positively to competitiveness in advanced economies.

Changes in Standard REER and Two Alternatives

(cumulative percentage change, 2000-11)



Sources: OECD, Fund staff estimates.

33. Incorporating GVCs seems to improve the fit of trade data, but more work is needed to assess empirical relevance as well as applicability to the Fund's surveillance work. A simple net export equation is estimated using the standard REER and two alternative REERs (Bayoumi, Saito and Turunen, 2013). Because of the presence of time-series properties in data, the dynamic panel data analysis is applied. The net export equation is assumed to be a function of trading partner's output, its own output, and real effective exchange rates, measured either in terms of the standard REER or the two alternatives. Given that net export is a value-added concept, REER-in-Tasks and REER-in-Goods should (in theory) be equivalent in fitting net export data. The results show that REER-in-Tasks and REER-in-Goods are both improvements in terms of fitting net export data when the new indices rather than the standard REER are used as regressors. More analysis is however needed in exploring the implications of the new indices for assessments of exchange rates. Staff are studying the new indices for their possible use in future assessments. Because such assessments are usually based on REER time series over decades, and because divergences from the old indices can gradually accumulate and become substantial over such time spans, the new indices have the potential to make a significant difference.

34. In summary, the main findings are as follows:

- *Incorporating GVCs in measures of the REER provides new insights on competitiveness.* The difference between measures of the REER that account for supply chain trade and the standard formula of the REER comprises differences in weights (i.e., gross versus value-added trade weights) and in prices (CPI versus GDP deflator), and most of the difference comes from the latter. The empirical findings are therefore similar to studies comparing the use of different price indices in computing the REER.

- *Differences between the rate of change in relative prices of goods (reflected in GOREER) and that in relative factor prices (reflected in VAREER) are typically small. For emerging market economies with larger roles of outsourcing, however, larger differences are observed.*

D. Policy Implications

35. It is useful to monitor REERs computed using alternative price measures. Given that using different price indices make non-trivial differences, monitoring REERs computed using alternative price measures—especially, GDP deflators—where reliable price data are available can provide valuable information. New measures of REERs incorporating GVCs are therefore helpful additions to the existing toolkit.

36. Further work on measurement and the applicability of these indices is however needed to operationalize these indices fully. Value chains pose a challenge to standard measurement. They imply relationships that go beyond a buyer and seller of goods. Changes in exchange rates between countries that are integrated in a regional value chain may therefore be more important than indicated by the standard REER measures. New measures of REERs are one step forward in the right direction. Ongoing surveillance work (for countries for which these indicators are available) can act as “beta-tests” of these new indicators in evaluating and assessing how they can be best used in the Fund’s surveillance work in the future. These new measures of REERs incorporating GVCs hold out the promise of becoming helpful additions to the existing toolkit.

POLICY-MAKING IN THE WORLD WITH GVCs

37. This section explores the relationship between trade and trade-related policies and the increasing internationalization of production. GVCs make international commerce more intricate. The emerging pattern of trade and trade-related policies reflects the reality of this complexity. Section A illustrates how supply-chain trade changes the welfare effects of traditional protectionist measures, such as import tariffs. In fact, recent research suggests that the growing internationalization of production has played a significant role in limiting the use of these instruments. Nevertheless, it is important to examine the impact of trade restrictiveness measures and of other forms of trade barriers on the evolution of GVCs. A second dimension of complexity results from the trade-investment nexus created by the international fragmentation of production. Section B documents these relationships and discusses how the evolution of GVCs affects and is affected by domestic disciplines, such as those that protect investments and intellectual property rights. This interaction implies that barriers to trade increasingly originate behind rather than at the border. In this environment, a demand for new forms of governance arises, which is often met in “deep” FTAs. Finally, Section C concludes by focusing on selected policy implications.

A. Protectionism and GVCs

38. The growing importance of GVCs in international trade has been accompanied by a reduction in the use of traditional protectionist measures. Tariffs, particularly those imposed by developing countries on imports of parts and components, have been progressively declining in recent years. Governments have negotiated tariff cuts in the context of multilateral and free trade agreements or simply chose to unilaterally reduce their use, most notably in East Asia. A recent study relates these policy developments to the growing importance of supply-chain trade (Baldwin, 2010). A possible explanation, which finds supports in the data, is that developing countries reduced tariffs on intermediate goods to attract investments by multinationals that were relocating parts of their production chain. This competition for investments gave rise to a series of unilateral and mutually reinforcing tariff reductions (Vezina, 2010).

39. Moreover, the changing nature of international trade is widely seen as a muting factor of trade protectionism during the financial crisis. Governments tend to use protectionist measures, such as tariffs or anti-dumping duties, counter-cyclically (Bagwell and Staiger, 2003; Knetter and Prusa, 2003). Intuitively, governments may attempt to respond to a negative macroeconomic shock by restricting imports to sustain domestic production and employment at the expense of trading partners. However, Bown and Crowley (2012) find that the protectionist response to the Great Recession has been substantially muted relative to the average countercyclical response during 1988–2008.²⁹ A leading explanation is that supply-chain trade changes the political economy

²⁹ Nonetheless, Henn and McDonald (2011) show that despite the limited use of protectionist measures in the aftermath of the financial crisis, significant damages are observed in product-level trade.

of protectionism, as firms that operate in GVCs have different trade policy preferences than firms that do not, thus creating a countervailing pressure against protectionism.³⁰ Consistent with this view, Gawande, Hoekman, and Cui (2011) show that the intensity of vertical specialization, which captures the importance of imports in exports, helps explain the stable tariffs following the Great Recession.

40. Having said that, it is worth emphasizing the negative impact of traditional trade restrictiveness measures on the growth and resilience of GVCs. While, as argued above, the changing nature of trade has contributed to maintaining an open trading system, the other direction of causality (i.e., from low and stable tariffs to a greater internationalization of production) is probably equally relevant. Intuitively, an open trading environment promotes the growth and resilience of GVCs by reducing the costs of offshoring associated with the uncertainty regarding future trade policy developments. To show this point, staff examined the impact of trade restrictiveness measures on both gross and value-added exports (relative to GDP). A simple analysis that uses the WIOD data (described earlier) shows that a negative impact of trade restrictiveness, captured by the Overall Trade Restrictiveness Index (OTRI), on gross exports is not statistically significant.³¹ In contrast, a statistically significant negative impact of trade restrictiveness on value-added exports is observed, indicating that trade restrictions do not seem to hurt gross trade per se but seem to hurt countries' increase in value added or income through exporting.

Static Panel Data Analysis¹

Dependent Variable:	Sample Period: 1995-2005	
	(1) gross	(2) value added
OTRI ²	-0.043	-0.181**
R ²	0.973	0.971
No of countries	33	33
No of observations	373	373

Sources: Fund staff estimates.

¹ The FE estimator with period dummies is used.

The explanatory variable is of previous period.

² The OTRI from the UNCTAD.

³ Exports to GDP ratios are normalized to take values upto 1.

41. In addition, recent studies show that a number of trade facilitation bottlenecks are more important to supply chains than traditional trade policy measures. Even in the absence of tariffs, the poor quality of transport and logistics (e.g., express carriers) service markets, the inefficiency of border management (e.g., border processing days), the regulatory requirements for importing and exporting have an adverse impact on the internationalization of production. The reason is that these bottlenecks to trade facilitation substantially increase trade costs. A study that

³⁰ Domestic users of imported inputs will favor low tariffs on intermediates, while domestic producers that offshore the last stage of production and re-import the final goods will oppose tariffs on these products. A similar logic, and a similar conflict between firms that operate in GVCs and firms that do not, applies to temporary trade barriers such as anti-dumping duties.

³¹ The FE estimator with time dummies applied here would take care of two sources of endogeneity (i.e., presence of individual heterogeneity and period effects). Simultaneity between trade policy choices and the level of exports relative to GDP is dealt with by using explanatory variable of the previous year.

uses a newly collected dataset by the World Bank finds that improving logistics performance would on average reduce trade costs ten times more than the equivalent reduction in tariffs (Arvis and others, 2013).³² A second report, World Economic Forum (2013), based on 18 company-level case studies, concludes that a concerted effort to reduce supply chain barriers to levels observed in the best-performing countries could increase global GDP by some 4.7 percent—six times more than what could be achieved from eradicating all remaining import tariffs.

42. How exchange rate volatility affects supply-chain trade is an open (and pressing) question. Unpredictable exchange rate policies may in principle also contribute to adversely affect supply-chain trade, either by increasing policy uncertainty or by distorting off-shoring decisions by transmitting incorrect price signals. A large body of literature studies the impact of exchange rate volatility and misalignments on trade flows (Box 6). However most of the literature, including the analysis of the issue done by Fund staff in 2004 (IMF, 2004), does not distinguish between trade in tasks and trade in final goods. An exception is recent work by the ADB, which focuses on intra-Asian trade differentiating by different types of goods (Tang, 2011). The study finds that the adverse trade impact of exchange rate volatility is most evident for intermediate and equipment goods. This suggests that trade in tasks does indeed respond differently from trade in final goods, most likely because this type of trade is more sensitive to the trade costs created by policy uncertainty.

³² Arvis and others (2013) use standardized regression coefficient to compare betas from variables that have different units of measurement, such as tariffs and logistics performance indicators.

Box. 6 Trade and Exchange Rate Volatility³³

Does the volatility of exchange rates impair international trade? This is a recurrent question in the trade community and has been the object of a large number of theoretical and empirical studies (see Auboin and Ruta, 2011). While these studies are useful in shedding light on several issues concerning the relationship between exchange rate volatility and trade, a number of questions remain open, most notably on how volatility may affect supply-chain trade. This box offers an overview of the main findings in the literature.

The theory indicates that exchange rate volatility can adversely affect trade flows, but this negative relationship is not robust. The presumption that exchange rate volatility will reduce trade flows is based on the idea that risk-averse producers will be less willing to export in a more uncertain environment. The seminal model capturing this idea (Clark, 1973) rested on a number of assumptions that were relaxed in subsequent studies, helping to define the contour of the relationship between exchange rate volatility and trade. In particular, the degree of risk aversion of domestic producers, the availability of financial instruments to hedge exchange rate risks, and the extent to which such hedging translates into higher costs for exporters are all elements that contribute to explaining the impact of exchange rate volatility on trade flows. As these elements tend to vary across countries, firms and sectors the theory suggests that the trade effect of currency volatility may be subtle and poorly captured by aggregate data. A further complication highlighted by the theory is that exchange rate volatility can be endogenously determined by variables, such as monetary and fiscal policy, that may have an independent impact on trade flows. In this general equilibrium context, the trade impact of exchange rate volatility is more difficult to establish (IMF, 2004).

The evidence supports the view that the adverse effect of exchange rate volatility, if it exists, is not large. Recent empirical studies are generally based on gravity models that attempt to isolate the impact of bilateral exchange rate volatility on trade by controlling for a number of other determinants of bilateral trade flows, such as geographical distance or GDP. Employing this approach, IMF (2004) finds that exchange rate volatility reduces trade (if volatility were to rise by one standard deviation, bilateral trade would fall by 7 percent), but this effect is not robust to different specifications. An additional empirical problem is the proper identification of the causal relationship. It is possible that countries attempt to stabilize exchange rates (and, at the limit, choose to form a monetary union) in order to promote bilateral trade. Failing to control for this reverse causality may lead to over-estimate the negative impact of exchange rate volatility on trade flows. Various studies have used different instrumental variable (IV) approaches to deal with this problem, reaching different conclusions on the strength of the impact of the stability of exchange rates (or of currency unions) on international trade (e.g., IMF, 2004; Santos Silva and Tenreiro, 2010).

The theoretical and empirical literature has so far paid little attention to the impact of exchange rate volatility on GVCs. As discussed above, the literature has long recognized that the effect of currency volatility on trade may well differ across country groups (i.e., developed versus developing), firms (i.e., large versus small producers), or sectors (i.e., homogeneous versus differentiated products). IMF (2004) finds support to the idea that disaggregated trade may provide useful insights, even if the effect of exchange rate volatility on (disaggregated) trade remains poorly robust. In light of this, an important question is how exchange rate volatility affects trade in tasks as opposed to trade in final goods. In principle, there are a number of reasons why the relationship between currency volatility and trade may depend on the nature of trade. One argument is that trade costs, as the ones created by exchange rate uncertainty, may be more relevant in the case of supply chain trade. Another argument, which runs in the opposite direction, is that firms operating in multiple markets through GVCs are less affected by volatility as changes in exchange rates create offsetting effects. The evidence in Tang (2012) for Asian countries suggests that the first effect may dominate, but further work is needed.

³³ Prepared by Michele Ruta.

B. “Deep” Disciplines and GVCs

43. The fragmentation of the production process across different countries creates a strong trade-investment nexus. Theory has long distinguished two main types of FDI: horizontal and vertical (Markusen, 1984; Helpman, 1984). Horizontal FDI is said to be ‘market seeking’ while vertical FDI is ‘efficiency seeking’. In the first case, FDI tends to substitute for trade in final goods, as firms choose to service a foreign market by setting up a local production subsidiary. In the second case, FDI tends to complement trade, because production entails trade in intermediate inputs between multiple divisions of the same firm. Evidence shows that the stock of inflow FDI is associated with an increase in gross as well as value-added exports, which indicates the growing complementarity between foreign investments and trade through production sharing. Underlying this relationship, there are complex sourcing and integration strategies of firms that are affected by both trade costs (as the ones arising from bottlenecks to trade facilitation) and comparative advantage across stages of production.³⁴

Static Panel Data Analysis¹

Dependent Variable:	Sample Period: 1995-2008			
	total	(1) gross		(2) value added
		final	interm.	
FDI ²	0.041**	0.067**	0.032**	0.023**
R ²	0.960	0.942	0.966	0.968
No of countries	31	31	31	31
No of observations	370	370	370	370

Sources: Fund staff estimates.

¹ The Fixed Effects (FE) estimator with period dummies is used.

The explanatory variable is of previous period. ** and * denotes statistical significance at the 1- and 5-percent levels, respectively.

² FDI as a share of GDP, calculated using the OECD FDI Multilateral Position data.

³ Exports to GDP ratios are normalized to take values upto 1.

44. The trade-investment nexus increases the complexity of international commerce, changing the boundaries between trade and domestic policy. The internationalization of production intertwines flows of goods, investment, services, technology, and people across different borders. As discussed in Baldwin (2011), this internationalization is very different from traditional trade in final goods as firms face the necessity of connecting factories located in different countries (e.g., moving personnel, capital, and technology) and of doing business abroad (e.g., setting up production facilities). In this context, efficient policy-making faces two challenges. First, domestic policies are a more important barrier to international trade. For example, weak protection of intellectual property rights (IPR) and of investment rights has a negative impact on GVCs as offshoring increases the international exposure of a firm’s knowledge and capital. Second, the rise of off-shoring creates new forms of cross-border policy spillovers that go beyond the terms-of-trade effect, the standard trade policy externality (Antras and Staiger, 2012). Intuitively, new policy

³⁴ Differences across countries, including policies, quality of institutions, development of the financial sector, generate comparative advantage and thereby contribute to explaining the patterns of trade and FDI (Helpman, 2006; Antras and Yeaple, 2013). An important issue, not discussed in this paper, is what policies allow developing countries to acquire a larger share of value-added trade in a GVC context.

spillovers emerge because governments do not take into account the full value of the international production chain, but only of its domestic component. These challenges create a demand for international policy agreement (either to help governments make commitments or to internalize international policy externalities).

45. In fact, new rules and disciplines underpinning the rise of “supply-chain trade” have been and continue to be written, often outside the multilateral trading system. Rules and disciplines underpinning supply chain trade are primarily in newly negotiated FTAs, and are in part addressed through bilateral investment treaties (BIT) and unilateral reforms of domestic institutions in developing and emerging economies. WTO (2011) documents that “deep” integration characterizes an increasing number of FTAs, as these agreements often include legally enforceable provisions that go beyond WTO commitments and regulate policy areas that are not covered by the WTO agreements. The study surveys 96 FTAs covering 90 percent of world trade and finds that the core disciplines introduced in deep agreements are competition policy, IPR protection, investment, and movements of capital. Exploiting this dataset, Orefice and Rocha (2011) show that there is a two-way relationship between deep integration and supply-chain trade. Specifically, the probability of signing a deeper agreement is higher for country pairs that share GVCs, while signing deeper agreements increases trade in parts and components by almost 35 percent.³⁵

C. Policy Implications

46. Improving the growth and resilience of GVCs requires maintaining an open trading system and addressing trade facilitation bottlenecks. The use of traditional trade restrictive measures has been limited in the aftermath of the crisis, in part because of the increasing importance of vertical specialization. But this does not imply that traditional forms of protectionism are no longer a threat, because they are even more costly for GVCs. Monitoring of traditional trade policy will continue to be important, particularly in a world economy characterized by slow growth, high unemployment and limited domestic policy tools. In addition, attention should focus on addressing the other measures, such as regulatory requirements for importing and exporting, that increase trade costs and create supply chain barriers. Specifically, reaching a multilateral Trade Facilitation Agreement in the 9th WTO Ministerial Conference in December 2013 would be an important step.

47. The increasing importance of deep FTAs as negotiating forums to discipline GVCs creates challenges and opportunities. The fragmentation of the production process across multiple borders creates a demand for governance which is often met at the regional/bilateral level rather than within the multilateral trading system. In part, this is due to the fact that negotiating market access concessions is fundamentally different from negotiating deep disciplines, for which policy preference and needs vary widely across countries. This fact raises the difficult institutional

³⁵ Trade in parts and components is a useful, but imperfect, measure of supply-chain trade. It is useful, because data on trade in parts and components are available for a large set of countries. However, it is often difficult to properly identify intermediate goods in customs classifications.

question of what is the optimal allocation of competencies between the WTO and the deep FTAs (Baldwin, 2012). However, the uncoordinated growth of these agreements creates a risk of regulatory segmentation of the trading system and of exclusion or discrimination in trade relations, forcing latecomers to adopt rules negotiated by others. More analytical thinking and negotiating energy should be devoted to finding ways to improve the coexistence of FTAs and the WTO—that is to “multilateralize” regionalism.

48. The relationship between deep FTAs and GVCs has consequences for the transmission of macroeconomic shocks and the effects of trade agreements.

- The pattern of deep agreements is shaping and is shaped by GVCs. As argued above, this is likely to create market segmentation, which will have consequences for transmission of macroeconomic shocks through supply chain trade. Specifically, deep FTAs will magnify the transmission of shocks between members and reduce them between members and non-members.
- Models that provide estimates of the effects of trade agreements, such as traditionally done in computable general equilibrium models, focus on the consequences of removing high tariffs in protected sectors. However, deep FTAs such as the Trans-Pacific and the Trans-Atlantic Partnerships are mostly about behind-the-border measures, many of which relate to cross-border production. Hence, the growth and welfare effects of these agreements may be substantially different from the ones suggested in the current policy debate.

49. In a world where GVC trade is more important, the impact of capital controls and exchange rate fluctuations deserve more careful analysis, especially by international organizations.

- Given the close association between cross-border capital flows and the growth of GVCs, analyses of trade and capital flows and of the measures aimed at restricting such flows should be carried out in tandem.
- Short-run and long-run fluctuations of exchange rates are likely to have significantly different effects on trade in final goods relative to supply-chain trade. But the latter are poorly understood in the academic literature and often absent from the policy debate.

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