

GLOBAL PRODUCTION NETWORKS: LABOUR MARKET IMPACTS AND POLICY CHALLENGES

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Abstract

The labour market dimension of global production networks has been extensively examined in the academic literature. The general conclusion is that the effects of offshoring are moderately negative. However, this literature is based on broad definitions of materials and services offshoring. This paper attempts to add to this evidence by examining the phenomenon from two distinctive perspectives. The first is to disaggregate the type of offshoring including both high and low technology materials and services offshoring. The second is to differentiate these impacts across worker skill levels. We find that, unlike previous studies, high technology manufacturing has a large impact on both high and low skilled workers. We also find evidence that there are significant positive spillovers in the demand for services workers from this offshoring. These effects appear to be mainly from offshoring to developing economies and not, as previously found, OECD economies. We further find evidence that these impacts vary by level of sectoral productivity growth and amount of product market regulation found in the domestic economy.

JEL Codes: F1, F15, F16

I. Introduction

While firms have been using production networks to increase efficiency, profits and value for decades, such networks have proliferated markedly during this most recent period of globalisation. Technological changes—resulting in cheaper telecommunication, transport, and computing costs—as well as trade and investment liberalisation, have rapidly accelerated the growth of production networks. Today, the division of production processes into increasingly smaller components that are then outsourced or offshored is more complex, and has increased its international dimension.¹ These changes have redefined the way in which many firms trade goods and services, especially intermediate inputs. As a result, production networks present workers with both opportunities and challenges.

Trade theorists Jones and Kierzkowski (1990) developed a general framework of production networks, dubbed ‘fragmentation’. Further work by Gereffi, *et al.* (2005) developed the concept of global value chains. The OECD (2001, 2007, 2008, 2011a) among others, built upon this pioneering work, substantially expanding our understanding of production fragmentation from a trade perspective. Production fragmentation has been shown to benefit both producers and consumers (see Moran, 2002; Feenstra *et al.* 2002). Indeed, firms use production networks to take advantage of cost savings or productivity enhancements gleaned from externally supplied inputs (outsourcing) or from abroad (offshoring). Consumers benefit from an expanded variety of goods and services at lower prices. Workers benefit from opportunities provided by new ventures and services supporting these networks.

However, a very real fact is that workers can also lose when industries offshore jobs and subsequently import inputs. While job losses due to import penetration are often small and industry-specific, widespread concerns remain in many developed countries that domestic workers are at risk with any increase in imports. Thus the expansion of production networks, and the many ways in which they source inputs globally, has increased perceptions that workers, particularly low-skilled workers, are ‘victims’ of globalisation. Supporters of liberalisation argue that workers who lose jobs in import-competing industries can seek employment in expanding export industries. After all, exporting firms that expand operations by entering new markets or boosting production in existing markets, have been shown to create more (and better paying) jobs. However, there are many reasons why this is often not the case, as labour market adjustment can be a costly and slow moving, and may even be exacerbated by the institutional structure of the economy (Davidson and Matusz 2000).

From the perspective of global production networks or global value chains (GVCs)² labour market impacts are not expected to be uniform across occupations, tasks or skill levels, nor are the interactions between these three concepts consistent (e.g. Crinò 2010). There is an explicit distinction between tasks (seen as a unit of activity that produces output) and skills (a worker’s endowment of capabilities for performing various tasks), while occupations can be viewed as bundles of tasks. Skills do not directly produce output, but are applied to tasks to produce output. In this task-based framework, workers of a given skill level can perform a variety of tasks and the set of tasks they are assigned to can change in response to changes in labour market conditions and technology (Acemoglu and Autor, 2010). Thus as GVCs respond to changes in technology, the types and locations of tasks employed will change, often in unpredictable ways.

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1. The term *outsourcing* is used to describe goods and services produced outside the enterprise. Outsourcing can occur within the country where the enterprise is located (domestic outsourcing) or abroad (outsourcing abroad). *Offshoring* is a more generally used term to describe outsourcing abroad. Offshoring can refer to the production of goods and services, partially or totally, within the same group of enterprises, or to those transactions occurring with a non-affiliated enterprise. See OECD (2007) for a more detailed discussion,
 2. We use the terms ‘global value chains’ and ‘global production networks’ interchangeably.

As consumers of a continuum of tasks, production networks impact employment in diverse and sometimes opposing ways. Offshoring itself can lead to less labour intensive domestic production, as firms seek lower labour costs overseas. However offshoring has also been found to raise productivity and profitability (Amiti and Wei 2006) that provide employment opportunities. This combination often leads to an employment growth sufficient enough to offset job losses due to a fall in labour intensity in the domestic economy (Hijzen and Swaim, 2007). However, the type of offshoring also matters when measuring overall employment effects. Offshoring within the same industry has been shown to reduce the labour intensity of domestic production in general, but to have little effect on overall employment (Hill *et al.* 2008). Inter-industry offshoring, on the other hand, is shown to have little impact on labour intensity, yet a positive impact on overall employment (OECD *et al.* 2010). Thus the ultimate labour market outcome depends on the interaction of these events as well as the interaction of the tasks themselves (Lanz *et al.* 2010). As firms increasingly take-on the GVC business model, understanding the impact of trade liberalisation on firm's operating decisions has become more important than ever. Moreover, the implications for employment are essential in evaluating the ultimate economic effects of this new model, as well as the political sustainability of continued trade liberalisation.

To reap the benefits of specialisation that lead to increased efficiency, production networks rely on access to overseas markets. This means that, from the domestic market perspective, unimpeded access to imports. What many years of research have shown is that access to imported goods and services can increase productivity, output and growth (for example, Goldberg, *et al.* 2010, Stone and Shepherd 2010) supporting job growth. However, it has also shown that increasing imports leads to the loss of certain businesses that are unable to compete effectively, leading to job losses as well. The net effect has, over time, been shown to be positive with increased job opportunities in the domestic market. However, the details of the process matters as some newly unemployed workers are not always suitable for the jobs created, and thus a gap emerges between those afforded new and better opportunities and those facing long term unemployment. It is this gap that should be of concern – not the imports themselves.

Given GVCs reliance on open trading systems, trade policy plays a crucial role in determining the rate of offshoring because it affects the mobility of goods and services across national boundaries.³ However, the increasingly intricate global landscape makes the domestic employment impact of any future trade liberalisation unclear *a priori* and thus difficult for policymakers to assess the potential costs of. Despite this uncertainty, access to international markets needs to remain a policy priority. While successive rounds of regional and multilateral negotiations have reduced tariffs among both OECD and non-OECD countries, the remaining barriers have become more significant and new non-tariff barriers have emerged. Scope for further tariff reduction among developing economies and emerging markets also remains unfinished business, especially in services trade.

But trade policy is not the only policy that affects employment in the presence of offshoring. The domestic policy environment also plays a role (Gereffi 2006). Thus it is important to understand the complete policy picture when examining the relationship between employment and global production networks. The OECD-led project, ICITE, has produced a series of papers studying various aspects of the trade and labour market nexus.⁴ This body of research has concluded that policies that embed trade reforms in a context of macroeconomic stability and a sound investment climate on the one hand, and protect workers and facilitate transitions on the other, can play an important role in realizing the potential wage, employment and income gains associated with trade.

3. Other policies, such as tax and of course labour market policies are also important determinants of offshoring activity as discussed later in this paper.

4. More information on the International Collaborative Initiative on Trade and Employment (ICITE) can be found at http://www.oecd.org/site/0,3407,en_21571361_47076802_1_1_1_1_1_1,00.html.

While there is a large literature on the effects of trade and trade policy on labour market outcomes, there is only recently emerging work that encompasses policy, employment and production networks. Most trade models predict little aggregate employment impacts from trade liberalisation in the long run. Trade is generally considered to affect the labour market through a reallocation process as well as through changes in short-run aggregate demand (i.e. unemployment). As a result, the empirical literature has tended to concentrate on examining these reallocation patterns within and between industries where short run costs may be incurred. For the most part, economists argue that longer run opportunities resulting from trade opening have a net positive impact on employment via more productive and higher paying jobs.

Yet the increasing complexity and internationalisation of modern production networks compels policymakers to think carefully about GVCs' effects on trade, productivity, and employment. Has globalisation, in which outsourcing and offshoring play a key role, led to net job losses? Have policies affected the participation of firms in global production networks and therefore affected employment opportunities? Do the benefits (and costs) of production networks vary by industry or level of development? This paper aims to examine these issues.

The purpose of this paper is to build on previous OECD work to examine fundamental questions concerning the impact of production networks and global value chains on domestic labour market in OECD economies. We know that the effects of offshoring, broadly measured, differ by skill type, sector and even trading partner (Ebenstein *et al.* 2011). We also know from the trade literature, that more productive firms tend to engage in international activities (Bernard and Jensen 2004). Finally, we know that for some destinations offshoring is driven by cost consideration (the most obvious being access to less costly labour) while some is driven by clustering or other productivity/agglomeration motivations (Kimura and Obashi 2011). What we don't know is how the interaction of these forces affects labour demand.

This paper attempts to fill some of this knowledge gap by addressing the following research questions:

Have Global Value Chains/Production Networks, through offshoring, affected the domestic demand for labour? Does this impact differ for more productive firms?

Is the offshoring's impact homogeneous or does it depends on the type of activity that is offshored?

Is the offshoring's impact homogeneous or does it depend on the country where the activity is offshored?

Does the policy environment affect the degree of influence offshoring has on labour demand?

In order to examine these questions, we collected data across a number of OECD economies, depending in part, on newly developed data series that improves the estimation of both the source/destination of offshoring and the sector/country coverage of such activity.

II. How Production Networks Impact Employment

One of the most prominent features of globalisation is the rise of production networks or global value chains. As the ease with which 'jobs' could be broken into their various tasks increased, businesses began to improved efficiency and productivity by taking advantage of the long-proven strategies of division of labour and comparative advantage. These trends have led to a tremendous increase in world trade and incomes over the past 30 years. New opportunities have opened up along the whole economic hierarchy – from individuals to nations. In this sense, this period has been an exciting and beneficial one for the world economy, showing what a dynamic, innovative system it can be.

As inevitably comes with change, there are those whose fortunes may be hindered by the innovation and transformation of the global economy. Groups of individuals find themselves without the necessary skills to effectively compete for the new jobs; there is concern about the quality of those jobs that are available; economies that have flourished under the regimes of conglomerates covering every facet of the production process find themselves unable to develop the kinds of dynamic processes needed to keep up. Policy makers feel they are constantly two steps behind market trends, unable to react quickly enough, let alone anticipate, the changes instigated by the new global economy. This feeling of loss of control, epitomised by Freeman's 1995 article 'Are your wages set in Beijing?', by both workers and policymakers, creates a negative perception and suspicion of offshoring.

A major hindrance to policymakers is the sometimes contradicting analytics intended to guide them through the labyrinth of policy challenges. As has been made clear in the literature, current measurements of trade, investment and even jobs are inadequate to provide the kind of insights needed for well constituted policy formation.⁵ There is ample evidence that flexible labour markets, education and training opportunities are needed, but exactly how to implement these broad pieces of policy advice – and as importantly, estimating the types of tangible benefits needed to garner support for what can often be costly measures – are the questions of the day.

III. Methodology and Data

One of the primary roadblocks in the detailed analysis of global value chains is the paucity of data. Firm level data often lack the necessary detail to follow global value chain linkages – both within corporate structures and between third party intermediates. Industry trade statistics are reported in terms of gross flows and thus include the value of the same good each time it crosses an international border. While this is not a problem if we were trying to understand total flows, it is if we want to measure an individual economy's contribution to the flows or value added, and the components of that value added, for example labour costs (see Linden *et al.* 2009 for a discussion of the now-famous ipod example).

Progress is being made on all fronts to address these shortfalls. The WTO-led 'Made in the World' initiative is a multi-institutional undertaking to recast trade statistics to reflect the reality of today's global movement of goods and services. The OECD has played a major role in this endeavour with its work on measuring trade in value added, especially with respect to services. This project intends to construct global input-output tables that would aid in obtaining a better understanding of trade and investment flows (OECD 2011a).⁶

Until the time when trade statistics are a better reflection of value flows, economists will continue to use indicators in an attempt to capture the flow of goods and services as part of a global production network. This has traditionally taken the approach of measuring some form of offshoring. For example Feenstra and Hanson (1996) calculate the share of imported inputs in total intermediate inputs as a measure of labour-embodied offshore. Other approaches have used the relationship of imported intermediates to value added, total output, and levels of consumption. Alternatively, a more narrow definition put forward by Hummels *et al.* (2001) measures the foreign content of exports. In this study we apply a variety of

5. At major theme of the 2011 WTO Public Forum was *Made in the World and Trade in Value Added* which discussed issues of trade statistics measurement. The OECD's contributed session "Global Production Networks: What do they mean for Trade and Employment?" directly addressed this issue in the context of labour market impacts. See http://www.wto.org/english/forums_e/public_forum11_e/programme_e.htm

6 For details of this joint effort see *Measuring Trade in Value-Added: An OECD-WTO joint initiative* http://www.oecd.org/document/51/0,3746,en_2649_37431_49865779_1_1_1_37431,00.html.

measures to try and ascertain the true dynamics of the effect of offshoring on labour demand.⁷ These measures are important because offshoring is not just about ‘sending jobs overseas’ but about increases in efficiency through comparative advantage, and understanding the dynamics that make an economy grow and prosper and ultimately in a position to offer sustainable employment opportunities to all who seek them.

To develop a set of offshoring indicators, we make use of the most recent edition of OECD’s Input-Output Database, which includes an unbalanced database of 44 countries at several time periods (primarily 1995, 2000, and 2005).⁸ The recent inclusion of many more non-member economies in this comparable database greatly facilitates analysis and allows for more refined policy implications for developing economies. Input-output tables are very useful to describe global production network as they report information on the use of goods instead of the sometimes arbitrary classification schemes that divide goods into intermediate and other categories. Moreover, input-output tables also incorporate information on the use of services that allow us to measure the offshoring of service activities (De Backer and Yamano, 2008).

We proceed by using the various measures of offshoring in estimating labour demand to assess the impact of the international dimension of production networks (i.e., trade) on industry-level employment, following the general methodology documented in OECD (2007). Labour demand is estimated using both the conditional and unconditional models. In the conditional model, the optimal level of labour demand is determined by minimising production costs conditional on a fixed level of output. Labour demand is expressed as a function of wages, rental rate of capital, other input prices, and output.⁹

In the unconditional labour demand framework, profit maximisation occurs by choosing input quantities and output for given prices of inputs and output (in other words, capital is constrained).¹⁰ In this model, the profit-maximising quantity of factor demand is calculated by setting the partial derivative of profits to zero (i.e., hiring will be adjusted so that the marginal product of labour is equal to the wage). This model allows one to assess the overall impact of offshoring on labour demand. However, given the variability of output in this estimation procedure, unconditional demand equations are known to produce estimates that are less-than-robust (OECD 2007). Thus, for purposes of space and to focus the discussion, we present only our results for conditional demand estimation.¹¹

7 Horgos (2009) provides a detailed discussion of the various measurements of offshoring. He concludes that no one measure is consistently superior.

8. See Data Annex for more details.

9.

$\ln L_i = \alpha_0 + \sum_{j=1}^j \alpha_j \ln w_{ij} + \beta_k \ln k_i + \beta_y \ln y_i + \sum_{i=1}^L \gamma_i z_{il}$, the conditional labour demand equation for industry i , omitting country and time subscripts. Where: L =industry-level labour demand, w =wages and the price of materials, k =capital stock, y =output, and z =demand shifters that include offshoring and policy variables as well as R&D that is used to account for factor-biased technological change.

10.

$\ln L_i = \alpha_0 + \sum_{j=1}^j \alpha_j \ln w_{ij} + \beta_k \ln k_i + \beta_p \ln p_i + \sum_{i=1}^L \gamma_i z_{il}$, the unconditional labour demand equation for industry i , omitting country and time subscripts. Where: L =industry-level labour demand, w =wages and the price of materials, k =capital stock, p =price of output, and z =a set of additional controls for shifts in labour demand as described above.

11 Results for the unconditional demand estimation are available from the authors upon request.

Most studies examine measures of offshoring based on broad (intermediate inputs of a given sector for all sector inputs) and narrow (which measure only within sector imported intermediate inputs) definitions. But as recent studies have shown, more detailed analysis is required to understand the unique impact GVCs have on different sectors' offshoring and different labour groups (see Newfarmer and Sztajerowska 2012 for an overview). This is especially true of services inputs. Thus, to appreciate the degree to which different types of offshoring affect labour demand, we go beyond these two broad measures to look at certain types of industry offshoring. For example, high technology manufactures (e.g. pharmaceuticals), often requiring highly skilled workers are generally located in developed economies while low-technology processes (e.g. assembly work) requiring low-skilled workers is generally located in developing countries. The impact on domestic labour markets would be quite different across the two types of offshoring (i.e. high and low technology industries). Finally, there are reasons to believe that services, especially business services, are quite different as well (Gonzales *et al.* 2012). Thus, we concentrate on examining the impact of offshoring in low and high technology industries and business services.¹²

However, not all imported intermediate inputs are part of a value chain. Another way to get at participation in GVC is to examine trends in the Import Content of Exports (ICE) based on the Hummels, *et al.* (2001) approach. This measure comes closer to the idea of GVCs and the flow of the production processes across countries as it captures the contribution that imports make to the production of exports. There are strong links between imported intermediate goods and export performance (Beltramello *et al.* 2012). Thus to the extent that it captures the overall effect of the flow of goods and services as a result of production fragmentation across the entire process, it is a good proxy for the impact such a process had on domestic labour markets.

Trends in Offshoring

By most counts, offshoring has been increasing at a substantial, but slowing, rate among economies (Hill *et al.* 2008). Indeed, the pace of manufacturing offshoring across our sample countries appears to have slowed between 2000 and 2005, compared with the rate between 1995 and 2000 (figures 1 and 2). We see more, and larger, changes in high-technology manufacturing (figure 1) than low-technology manufacturing (figure 2) in 2005. OECD economies averaged almost 45% offshoring shares in 2005 in high technology manufacturing compared with 39% in 1995. Low technology was just over 35% in 2005 up from 30% in 1995. Non-OECD economies show a similar pattern averaging just over 20% for low technology and over 30% for high technology offshoring in 2005. Those economies seeing the biggest increase in offshoring in high technology are Luxemburg, China, Romania, Japan and the non-OECD grouping. Those countries with offshoring values above the 2005 OECD average include Austria, the Netherlands, Canada, Israel, Belgium, Poland and Mexico while Vietnam and South Africa are high offshorers for non-OECD.

Some countries decreased their offshoring in high technology industries. These countries include New Zealand, Australia, and the Slovak Republic. The Czech Republic experienced one of the largest decreases in offshoring for both high and low technology manufacturing, while other countries experiencing a decline in low technology offshoring include the Netherlands, Belgium and Indonesia. We see that Estonia has one of the largest increases in low-technology manufacturing offshoring.

12 High technology manufactures are defined as those sectors covering ISIC Rev3 2423,30,32,33,353; Low technology includes ISIC Rev3 15-22 and 36-37; Business Services include ISIC Rev3 50-74. Details can be found <http://www.oecd.org/dataoecd/5/30/40729523.pdf>.

Figure 1. Offshoring - Higher Technology Manufacturing

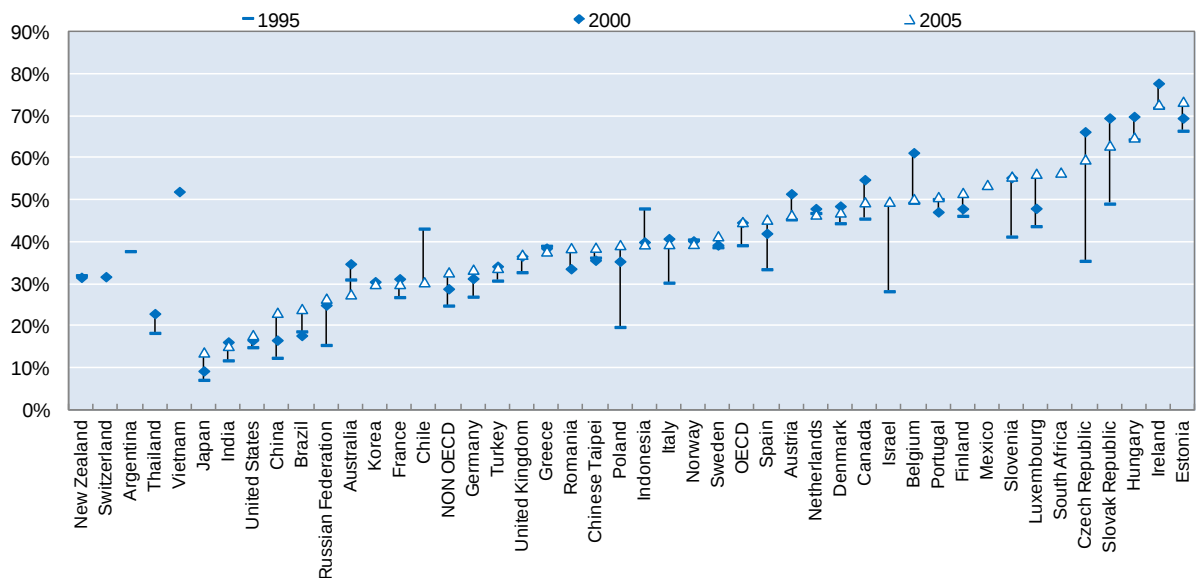
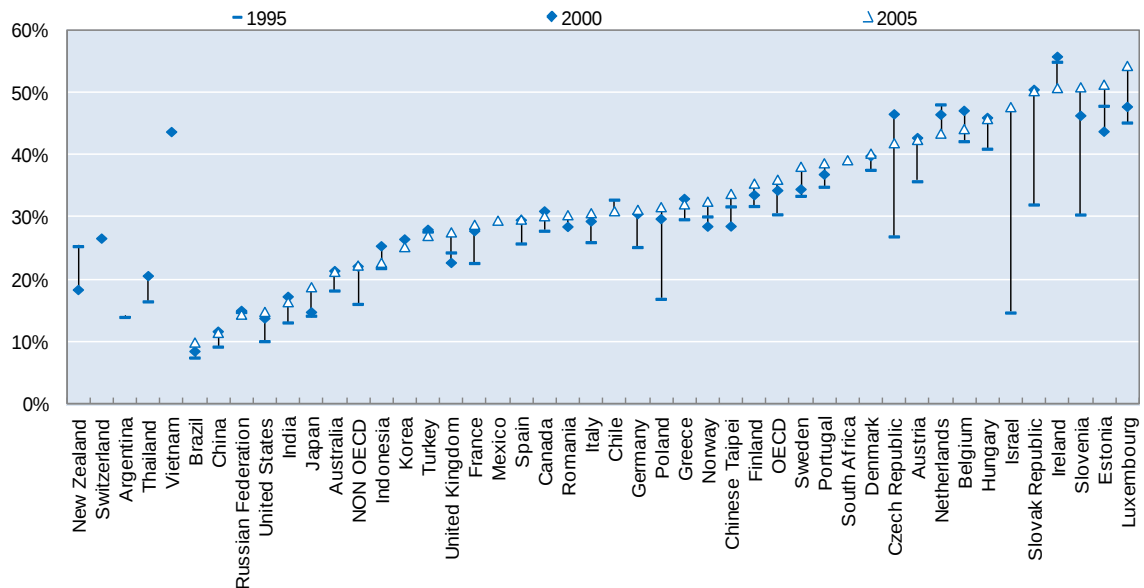


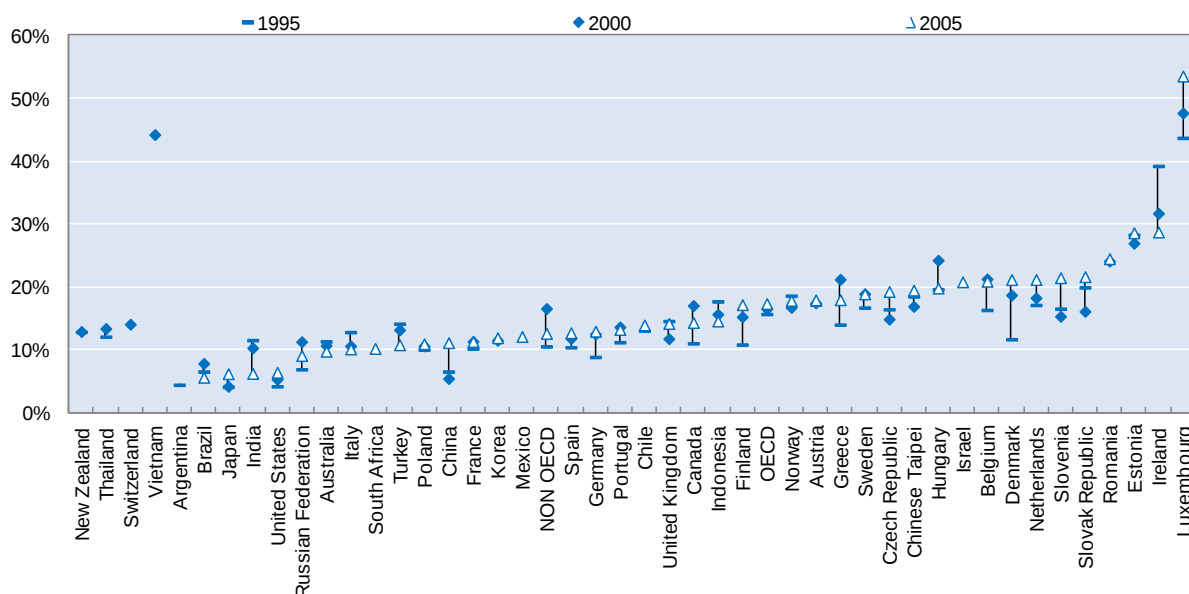
Figure 2. Offshoring - Lower Technology Manufacturing



The offshoring for business services (Figure 3) still accounts for a smaller share of trade in intermediates in both OECD and non-OECD economies (13% and 7%, respectively in 2005), but is growing. Among OECD countries there is a lot of variation in the service offshoring level: Japan and Italy report the lowest level (4%) in 2005, while Ireland and Denmark report the highest (29% and 23%, respectively). Luxembourg, once a leader in OECD services offshoring, has reduced its share over time. However, the data suggest that the growth of service offshoring during 1995-2005 was more rapid than

manufacturing offshoring in OECD countries. Moreover it was more stable across time. In non-OECD economies service offshoring follows the pattern of manufacturing offshoring: a sharp increase in 1995-2000 and a mostly negative performance in the early 2000s.

Figure 3. Offshoring in Business Services for All Industries



This analysis supports the idea that the pace of offshoring may have slowed somewhat, correcting an ‘overshooting’ of the offshoring mark and adjusting to more efficient levels (Baldwin and Venables 2010). However, it may also be a function of an evolving motivation for this activity. Global Value Chains are motivated to engage in production fragmentation for an increasingly complex set of factors (see, for example, A.T. Kearney 2011). The offshoring measure in so-called ‘low technology’ manufacturing – a segment usually driven by low-skilled jobs where reducing labour costs is of primary concern – was either unchanged or declined in 2005 for the majority of countries. A potential explanation for this outcome is that offshoring is no longer primarily driven by a search for ‘cheap’ overseas labour.

Trends in Import Content of Exports

Hummels *et al.* (1998, 2001) introduced the term vertical specialisation to analyse the impact of global value chains and provided a way of calculating both the direct and indirect inputs that drive the process of production fragmentation. Measuring direct imported inputs, as we do in the offshoring measures discussed above, we can get an indication of the direct contribution of foreign industries to the national production process. But this only gives part of the story. This vertical specialisation measure tries to reflect the process of a single production chain, linking imported inputs required by one country for the production of its exports. Imports and exports increasingly move together with the emergence of global value chains since the production process is increasingly characterised by sequential production and back-and-forth processes (DeBacker and Yamano, 2007). Several studies have computed this import content of exports (ICE) and found that vertical specialisation has been increasing over the years, illustrating the growing role of global value chains.¹³

13. See, for example, Yi (2003), the European Central Bank (2005) and Cardoso *et al.* (2007).

The OECD now provides ICE measures for 33 OECD and 15 non-OECD economies.¹⁴ By examining these values over time, we get a sense of the levels of participation in GVCs by country and sector. We first look at how countries rank with respect of manufacturing ICE (table 1).¹⁵ Hungary ranks first in both 1995 and 2005 implying a deep and consistent commitment to global production networks. Canada also remained highly ranked over the two periods with newly industrialised Poland, China and Korea replacing Italy, the UK and Germany (panel a). Values for ICE are higher across the board in 2005 than they were in 1995.

Panel b ranks the top exporting sectors according to their manufacturing import content. Here, office machinery ranks first in both 1995 and 2005 with the value of ICE increasing just over 25%. All five sectors ranked in 1995 continue to rank highly in 2005, with chemicals joining the top 5 and rubber moving to number 6. While all exporting sectors have increased their reliance on imported inputs, the largest gain was in radio, television and communications equipment which increased more than 36%. Finally it is noteworthy that 3 of the top 5 ICE values and 4 of the top 5 in 1995 and 2005, respectively, were in sectors classified as high technology.

Table 1 Top Ranking for Manufacturing Imports

a. Top Five Countries

1995				2005		
Rank	Country	Mean	Std. Dev.	Country	Mean	Std. Dev.
1	Hungary	0.230	0.184	Hungary	0.280	0.196
2	Luxembourg	0.169	0.123	Luxembourg	0.198	0.151
3	Canada	0.161	0.132	Poland	0.190	0.138
4	Indonesia	0.159	0.150	China	0.170	0.103
5	Chile	0.144	0.113	Canada	0.168	0.145

*No data available for S. Korea in 1995 and Russia in 2005

b. Top Five Exporting Sectors

	rank		Mean		Std. Dev.	
	1995	2005	1995	2005	1995	2005
Office, accounting and computing machinery	1	1	0.310	0.391	0.174	0.150
Motor vehicles, trailers and semi-trailers	2	3	0.266	0.311	0.163	0.142
Radio, television and communication equipment	3	2	0.244	0.332	0.146	0.166
Other transport equipment	4	4	0.217	0.269	0.105	0.070
Rubber and plastics products	5	6	0.215	0.248	0.107	0.114
Chemicals and chemical products	9	5	0.200	0.252	0.084	0.105

*No data available for S. Korea in 1995 and Russia in 2005

Turning now to services imports we see that Luxembourg was, and remains the highest user of services imports in its exports increasing this value by more than 80% between 1995 and 2005 (table 2,

14. The import contents of export indicator represents the degree of vertical specialization and measures the contribution that imports make in the production of exports of goods and services. Import contents of export = $u Am (I - Ad)^{-1} EX / \Sigma EX$, where Am and Ad are the input-output coefficient matrices for imported and domestic transactions, respectively, I is the identity matrix, u denotes an $1 \times n$ vector each of whose components is 1 for corresponding import types, and EX is the export vector.
15. That is, those countries with the highest levels of imported manufactured goods in total exports.

panel a). The only change in the country ranking for services was that Korea replaced Canada in the top five. As with manufacturing imports, values for services ICE increased across the board. More movement, however, can be seen in sector rankings (panel b). Finance and insurance ranking number 1 in 1995 was replaced by computer services in 2005 whose ICE increased over 60%. Transport and storage and other services continued to rank highly across the ten year period.

As noted above, it has been shown that business services play an important role in production networks, especially high technology manufacturing (Gonzales et al. 2012). We examine this relationship from the perspective of imports of services inputs to manufacturing exporting sectors (panel c). Exporting sectors using the highest amounts of imported services were almost exclusively in high technology manufacturing in 1995. However, by 2005 only 2 of the top 5 can be classified as high technology. This trend seems to contradict the observation that a growing amount of services offshoring is in support of high-technology production fragmentation.

Table 2 Top Ranking for Services Imports

a. Top Five Countries

1995				2005		
Rank	Country	Mean	Std. Dev.	Country	Mean	Std. Dev.
1	Luxembourg	0.105	0.092	Luxembourg	0.166	0.138
2	Hungary	0.043	0.024	Hungary	0.046	0.022
3	Canada	0.038	0.017	Italy	0.044	0.027
4	Indonesia	0.029	0.018	Chile	0.041	0.030
5	Italy	0.029	0.012	Germany	0.036	0.021

*No data available for S. Korea in 1995 and Russia in 2005

b. Top Five Sectors

	rank		Mean		Std. Dev.	
	1995	2005	1995	2005	1995	2005
Finance and insurance	1	2	0.062	0.072	0.103	0.154
Other community, social and personal services	2	5	0.050	0.048	0.090	0.089
Computer and related activities	3	1	0.047	0.077	0.051	0.156
Transport and storage	4	3	0.046	0.064	0.037	0.061
Renting of machinery and equipment	5	9	0.045	0.041	0.051	0.046
Other Business Activities	7	4	0.034	0.049	0.035	0.054

*No data available for S. Korea in 1995 and Russia in 2005

c. Top Five Manufacturing Exporters

Exporting Manufacturing Sectors

	Rank		Mean		Std. Dev.	
	1995	2005	1995	2005	1995	2005
Office, accounting and computing machinery	1	1	0.033	0.039	0.047	0.046
Medical, precision and optical instruments	2	8	0.027	0.028	0.027	0.027
Radio, television and communication equipment	3	7	0.024	0.028	0.028	0.020
Other transport equipment	4	11	0.024	0.027	0.034	0.028
Pulp, paper, paper products, printing and publishing	5	2	0.023	0.033	0.018	0.029
Chemicals and chemical products	7	4	0.020	0.030	0.012	0.022
Other non-metallic mineral products	8	3	0.020	0.032	0.014	0.033
Electrical machinery and apparatus n.e.c	15	5	0.017	0.029	0.013	0.030

*No data available for S. Korea in 1995 and Russia in 2005

How does skill level affect offshoring?

The reason firms offshore or outsource more generally is to reduce costs in order to competitively provide an output, be it a good or service. These outputs are made up of inputs that can be broken down into specific tasks requiring certain skills. The change in demand for labour across a particular GVC is driven by the decision to locate a particular task in order to maximise efficiency and minimise costs. Thus, from the point of view of labour markets, changes in demand for a worker are an outcome of this task placement decision and not a direct function of the underlying skills of a worker. Therefore it is not possible to say *a priori*, that ‘low skilled’ workers are more at risk, for example. Rather the outcome is a function of the ‘offshorability’ of the task at hand. The ability to offshore a task has to do with, among other factors, the routineness of the tasks and the degree to which interaction with other workers is required (Kierzenkowski and Koske 2012). Blinder (2009) argues that all manufacturing activities are offshorable while personal services, such as healthcare, are less easily offshored.

So how does skill relate to offshorability? One way this can be thought of is by examining the level of routine involved in certain occupations. In general, high-skilled workers perform “non-routine” abstract tasks (requiring problem-solving, intuition, and creativity, generally found in professional, managerial, technical and creative occupations). Medium-skilled workers often perform more “routine” tasks that are based on precise and well-understood procedures (occupations such as administrative work, repetitive production or monitoring). Like high-skilled workers, low-skilled workers often perform “non-routine” manual tasks that may not be easily offshored. These tasks may require situational adaptability, visual and language recognition, and personal interactions (in particular, a characteristic of service occupations such as personal health assistance or security services). Recent evidence suggests that impacts of offshoring are worse for workers who perform routine tasks (Ebenstein *et al.* 2011). Thus, we expect outcomes of offshoring to imply something about the number of routine tasks embodied in skill-defined demand.

Consistent with this relationship between skill and routine is the observed trend in the polarisation, or a ‘hollowing-out’ of the middle of the workforce (Goos *et al.* 2009). Polarisation is an increase in the shares of employment in both high- and low-skill jobs at the expense of medium-skilled jobs. In the European Union, for example, the share of total hours worked in the four lowest-paid occupations and the eight highest paying occupations increased 1.6 and 6.2 percentage points respectively from 1993 to 2006, while the share in nine middle income occupations dropped by 7.8 percentage points (Lanz *et al.* 2010).

In the US employment shifted from low skilled to high-skilled workers in a monotonous way during the 1980s with the higher skill levels rising faster than the growth in employment. During the 1990s, the share of medium-skilled workers began to decline, while the share of high-skilled workers rose sharply and that of low-skilled workers rose moderately. Finally, during the 2000s, the share of medium-skilled workers continued to decline, this time accompanied by a sharp rise in the share of low-skilled services workers while the share of high-skilled workers stayed relatively flat (Autor *et al.* 2010).

While it is not clear that the decline in medium-skilled workers can be attributed to offshoring, given the evidence presented, we expect to see some declines in the demand for these workers. To date, the evidence is that low-skilled workers were disproportionately harmed by offshoring. However, given the decline in the growth of low-technology offshoring and the general change in the characterisation of offshoring alluded to above, this generalisation may no longer hold. If the bulk of low-skilled work is indeed ‘non-routine’ we would not expect to see particularly large impacts on this segment of workers.

And the role of productivity...

We know that more productive firms export and that importing has a positive impact on productivity. But how does the relationship between offshoring and productivity affect labour demand? We have argued

that offshoring increases efficiency and enhances productivity, but we have not measured this effect directly. Indeed, while we are able to gain some insights into this relationship through the conditional labour demand equations, as it is a proxy of labour productivity already (measuring the change in labour demand at a given level of output), it does not measure how the interaction of productivity and offshoring may affect labour demand. As noted above, the ultimate impact of offshoring on labour demand may be positive or negative, depending on the task and the complementary demand for labour in the domestic market. Thus it is important to measure this productivity/offshoring effect. We do this by seeing if the impact of offshoring on labour demand is different for those sectors with higher productivity growth than it is for those with average, or below average growth.

Finally, we divide offshoring into OECD and non-OECD sources.¹⁶ If offshoring to non-OECD economies to about reducing labour costs in work such as assembly or basic garment production, we expect to see a large impact on low-skilled workers from non-OECD offshoring. If OECD offshoring were more about complementary processes we would expect to see less negative outcomes, or even positive impact, on labour demand.

IV Conditional demand results¹⁷

Table 4 reports the results for the conditional demand estimation for all manufacturing and services sectors for the three types of offshoring breaking down sources between OECD and non-OECD economies.¹⁸ As with other studies on general manufacturing (OECD 2007 and Hill *et al.* 2008), we see a consistent negative and significant impact on labour demand across skill categories for offshoring in high technology industries. Interestingly, we find no significant association with low technology offshoring, although signs are consistently negative.

If we look at the breakdown of OECD and non-OECD sources, the negative impact occurs when offshoring is to non-OECD economies (again, similar to earlier findings). This supports both the hypothesis that sourcing low-cost workers is driving some types of offshoring, as well as the idea that ‘routine’ tasks can be found across the skill spectrum. It also shows that these forces are just as applicable to offshoring in high technology industries as it was when such developments were isolated to low-technology processes. Also consistent with Hill *et al.* (2008), we find offshoring to OECD economies has a positive impact on workers, specifically medium skilled workers. We can infer from this outcome that offshoring in high technology industries to non-OECD countries may involved less skilled process that are offshored for cost-saving purposes while that to OECD economies involves complementary activities in the home market, stimulating labour demand.

The opposite appears to be happening in services sectors. The offshoring in high technology manufacturing has a strong positive impact on labour demand across all skill levels with the exception of high skilled, where the impact is negative but not significant. This results was foreshadowed in the 2007 OECD *Employment Outlook* that stated “This finding suggests that high skilled workers, heretofore a major beneficiary of globalisation, would be disadvantaged should services offshoring greatly expand, as some have predicted.” (OECD 2007, page 130.). The outcome also implies a strong complementary relationship between manufacturing offshoring and domestic services labour demand, a result consistent

16. We rely on newly developed OECD data that indicates what intermediate imports are sourced from which country. More details can be found in the Data Annex.

17. The results discussed in this section are robust to various types of offshoring measures.

18. Results were also found for all industries but are not reported as they did not differ significantly from the two sub-sectors. Sources of offshoring for business services were not available and thus the OECD/non-OECD breakdown is reported for manufacturing only.

with Gonzales *et al.* (2012). This may be a function of both complementary business services in support of high technology industry expansion as well as income effects of a more efficient thus potentially expanding, domestic high technology industry.

This first set of results points out three main messages: 1) among offshoring activities, offshoring of high technology manufacturing affects employment in OECD countries with opposite effects on manufacturing sectors (negative) and service sector (positive). In addition, the size of the coefficients in services is much greater than the negative manufacturing outcomes.¹⁹ While these results are consistent with the observation that high technology industries have increased their pace of offshoring, they do not support the notion of a ‘hollowing out’ of medium skill jobs; 2) the positive impacts of offshoring on services’ demand for medium and low skill workers are generally not found for their high skilled counterparts. An implication is that high skill work may be more affected by ‘bundling’ or the observation that certain tasks are not inseparable and this more difficult to offshore (Lanz *et al.* 2011); 3) offshoring towards non-OECD countries is the factor driving the negative impact on employment. The fact that this is occurring in high technology industries seems to confirm the observation that developing economies are growing increasingly sophisticated in their manufacturing base.

The influence of productivity growth

We now examine how these outcomes may differ for sectors with high productivity growth.²⁰ Manufacturing sectors with higher productivity growth record more hours worked without regards to the skill level (table5, columns 1-8), while the same does not hold in the service sector (columns 9-12). Further, the results show that the negative impact of high technology offshoring on medium and low skill does not depend on the productivity level. Productivity does appear to affect medium and low skilled workers. These workers employed in sectors with high productivity growth are negatively affected by the offshoring of low technology and business service activities and, unlike the result for the entire manufacturing sector, these results appear to be driven by offshoring to OECD countries. Hill *et al.* (2008) also showed evidence of a negative outcome on labour demand from manufacturing offshoring to OECD economies. We can infer from these results that high productivity sectors are substituting domestic workers with overseas OECD workers but whether this offshoring to other OECD economies is a *cause* of the above average productivity growth is impossible to say from these results.

For high productivity growth services sectors (columns 9-12) there is a significant negative impact on total hours for business services offshoring but a positive impact on the demand for low skilled workers. This implies that while highly productive manufacturing sectors substitute for low-skilled workers, services sectors labour demand actually expands. This same expansion can be seen in the demand for medium skilled workers from the interaction of high productivity and offshoring in high technology industries.

The focus on sectors with high productivity growth has shed light on the negative effect of low technology and business service activities on medium and low skill workers employed in these sectors. However, services labour demand expands for these workers. This is consistent with evidence presented in Crinò (2010) who found that services offshoring was complementary to demand for locally produced services. We find no evidence that the negative impact of high technology offshoring on employment is influenced by the level of productivity growth.

19. Although this relationship does not necessarily translate into effects on the number of persons actually (un)employed.

20. High productivity sectors were identified using measure of TFP from EUU KLEMS. Those sectors identified as ‘highly’ productive are those reporting above average growth rates for the sector and year.

The influence of Policy

What role has policy played? Over the years, trade policy reform has been quite successful, especially in the area of goods trade. OECD average tariffs on intra-OECD trade currently average less than 2% and less than 5% on non-OECD imports. These rates have been relatively stable over the years, and have not increased despite the recent Recession and slow recovery.²¹ Thus it is unlikely that much can be learned from examining changes in offshoring in response to changes in trade policy.

Complementary policies, on the other hand, do provide a useful area of analysis. Regulatory reforms across OECD countries are associated with developments in trade and investment patterns, not to mention reduction in trade costs (Hill *et al.* 2008). A useful measure of such reforms is the product market regulatory indicators developed by Nicoletti and Conway (2006) and regularly updated and reported by the OECD (2011b). These indicators take values from 0 to 6 (with 6 being the most restrictive) and contain measures of barriers to entrepreneurship, barriers to trade and investment and levels of state control.

Another important area of policy is labour market policy. Again, the OECD collects and reports on levels of employment regulation across both OECD and non-OECD economies.²² The indicators of employment protection measure the procedures and costs involved in dismissing individuals or groups of workers and the procedures involved in hiring workers on fixed-term or temporary work agency contracts. As an indication of labour market flexibility, it is natural to control for the level of employment protection when exploring the relationship between offshoring and labour market outcomes.

Consistent with OECD (2011a) we find that PMR protects low skilled workers while negatively affecting medium and high skill workers, although our results for medium and high skilled are not significant. When we consider the impact of product market regulation (PMR) and offshoring in labour demand in manufacturing we see that while high technology offshoring continues to have a negative impact on worker demand it is now focused on medium skilled workers (table 6, columns 1-8).²³ There is also a negative impact of business service offshoring on medium skill workers. However this is offset by the positive effect in countries with strong PMR, which also positively influences total hours worked. The results for high technology offshoring seem unaffected by the product policy environment. Low skilled workers, however, appear to be negatively affected by low technology offshoring in a high PMR environment.

While employment protection itself is negatively associated with high skilled labour demand in manufacturing, when interacted with offshoring it does not appear to have a significant influence. Thus, there appears to be no association with the level of employment protection and the degree of offshoring's impact on labour demand in the areas under investigation. This is consistent with previous studies (Hill, *et al.* 2008).

Again we see the positive influence offshoring appears to have on worker demand in the services sector (columns 9-16). High technology manufacturing has a positive and significant impact and while the interaction with PMR and offshoring is not significant, it does have a positive sign. However, the demand for workers in services sector seems to be negatively affected by business services offshoring, even taking

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21. The same might not be said for other potentially trade distorting measures such as countervailing duties and subsidies. However, the time period covered in this paper is prior to the crisis-induced increase in the introduction of such measures and thus would not be reflected in our results.
 22. It is important to note that employment protection refers to only one dimension of the complex set of factors that influence labour market flexibility. For information on other labour market policies and institutions in OECD countries, see the [OECD Employment Database](#).
 23. Highly regulated economies are defined as those with PMR and EP values above the OECD average.

into account the positive influence PMR has on offshoring's impact on demand. Once again, employment protection does not appear to play much of a role here.

So we can infer that while PMR matters to explain the offshoring effect on employment (negative effect of low technology industry offshoring on low skill workers and protecting medium skills from business service offshoring), the EPL seems more neutral. The impact of high technology offshoring on employment is not shown to be influenced by the policy environment.

Import Content of Exports²⁴

As stated above, ICE provides a different vantage point to the impact of production networks on labour demand by attempting to focus on those imports that are used directly in a country's exports (Table 7). When examined from this perspective, we see that the coefficients on ICE for both manufacturing (columns 1-4) and services (columns 5-8) are positive and significant for medium and low skill manufacturing workers and high skilled service workers. This implies that the efficiencies gained through the sourcing of manufacturing inputs overseas translate into higher demand for labour and is strong support for the arguments that GVCs bring efficiencies and spillover benefits to the domestic economy that have a positive influence on labour market demand. The increase in demand for high skilled workers in response to an increase in ICE services is consistent with the other findings that high skilled worker demand responds positively to services offshoring (Jensen 2011).

24. Interaction with high productivity sectors yielded similar results and thus is not reported. Breakdown of import source is not available for ICE estimates.

Table 3 Regression Results for Basic Offshoring Equations^a

	Manufacturing								Services			
	(1) Total Hours	(2) High Skill	(3) Medium Skill	(4) Low Skill	(5) Total Hours	(6) High Skill	(7) Medium Skill	(8) Low Skill	(9) Total Hours	(10) High Skill	(11) Medium Skill	(12) Low Skill
Relative Wages	-0.040 (0.032)	-0.085* (0.050)	-0.036 (0.039)	-0.015 (0.039)	-0.040 (0.033)	-0.084* (0.050)	-0.036 (0.040)	-0.018 (0.039)	-0.109*** (0.028)	-0.249*** (0.039)	-0.134*** (0.050)	-0.040 (0.067)
Capital	0.387*** (0.068)	0.378*** (0.100)	0.533*** (0.086)	0.409*** (0.085)	0.401*** (0.072)	0.377*** (0.104)	0.561*** (0.089)	0.442*** (0.088)	0.339*** (0.064)	0.421*** (0.111)	0.322*** (0.088)	0.510*** (0.110)
Output	0.294*** (0.054)	0.228*** (0.072)	0.277*** (0.054)	0.279*** (0.062)	0.287*** (0.058)	0.229*** (0.074)	0.265*** (0.059)	0.269*** (0.065)	0.212*** (0.062)	0.367*** (0.079)	0.264*** (0.079)	0.118 (0.102)
R&D Intensity	0.074 (0.185)	0.045 (0.410)	-0.119 (0.274)	0.163 (0.346)	0.071 (0.191)	0.061 (0.420)	-0.113 (0.250)	0.170 (0.382)	0.892 (0.915)	1.097 (1.921)	0.896 (1.212)	3.508** (1.645)
High Tech Manufacturing Offshoring	-0.103*** (0.040)	-0.135* (0.077)	-0.134*** (0.051)	-0.223* (0.113)					2.131*** (0.440)	-1.767 (1.109)	3.100*** (0.659)	2.612*** (0.812)
Low Tech Manufacturing Offshoring	-0.132 (0.122)	-0.138 (0.181)	-0.066 (0.146)	-0.008 (0.190)					0.182 (1.247)	-3.439 (3.835)	-0.064 (1.823)	-1.328 (2.174)
Business Services Offshoring	0.006 (0.011)	0.004 (0.016)	0.001 (0.013)	-0.005 (0.017)					-0.469 (0.292)	0.695 (0.637)	-0.715 (0.481)	-0.990 (0.950)
High Tech Manuf Offshoring - Non-OECD					-0.494** (0.218)	-0.336 (0.338)	-1.173*** (0.322)	-1.505*** (0.553)				
High Tech Manuf Offshoring - OECD					0.065 (0.108)	-0.038 (0.160)	0.297* (0.164)	0.280 (0.277)				
Low Tech Manuf Offshoring - Non-OECD					0.117 (0.556)	0.449 (0.753)	0.397 (0.570)	-0.125 (0.513)				
Low Tech Manuf Offshoring - OECD					-0.230 (0.175)	-0.334 (0.246)	-0.258 (0.198)	-0.019 (0.265)				
Business Services Offshoring - Non-OECD					0.171 (0.403)	-0.039 (0.360)	0.244 (0.417)	0.192 (0.319)				
Business Services Offshoring- OECD					-0.057 (0.152)	0.019 (0.136)	-0.092 (0.158)	-0.077 (0.122)				
Constant	-10.430 (1.532)	-6.141*** (2.180)	-9.510*** (1.976)	-7.817*** (2.075)	-10.590 (1.556)	-6.155*** (2.203)	-9.919*** (1.969)	-8.355*** (2.096)	-6.275*** (1.357)	-8.359*** (2.434)	-2.767 (2.074)	-6.459*** (2.407)
Observations	516	513	513	513	516	513	513	513	367	363	363	363
R-squared	0.645	0.513	0.528	0.773	0.648	0.516	0.540	0.776	0.504	0.694	0.419	0.387
Number of countries_sectors	185	184	184	184	185	184	184	184	134	132	132	132

a) variables expressed in natural logs. Regressions include time and industry_country dummies. Robust standard errors in brackets.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4 Regression Results with Productivity^a

	Manufacturing								Services			
	(1) Total Hours	(2) High Skill	(3) Medium Skill	(4) Low Skill	(5) Total Hours	(6) High Skill	(7) Medium Skill	(8) Low Skill	(9) Total Hours	(10) High Skill	(11) Medium Skill	(12) Low Skill
Relative Wages	-0.046 (0.031)	-0.099* (0.051)	-0.043 (0.038)	-0.025 (0.037)	-0.047 (0.031)	-0.101** (0.051)	-0.043 (0.038)	-0.032 (0.037)	-0.108*** (0.029)	-0.246*** (0.039)	-0.135*** (0.051)	-0.036 (0.068)
Capital	0.385*** (0.069)	0.428*** (0.100)	0.529*** (0.087)	0.433*** (0.085)	0.386*** (0.075)	0.423*** (0.106)	0.547*** (0.092)	0.454*** (0.090)	0.340*** (0.065)	0.423*** (0.111)	0.322*** (0.088)	0.512*** (0.110)
Output	0.299*** (0.055)	0.239*** (0.073)	0.281*** (0.054)	0.295*** (0.064)	0.295*** (0.059)	0.243*** (0.076)	0.274*** (0.057)	0.289*** (0.066)	0.212*** (0.063)	0.358*** (0.081)	0.269*** (0.081)	0.108 (0.105)
R&D Intensity	-0.091 (0.042)	0.120 (0.031)	-0.026 (0.025)	0.394 (0.032)	0.152 (0.186)	0.122 (0.422)	-0.049 (0.267)	0.329 (0.365)	0.848 (0.904)	1.191 (1.985)	0.853 (1.262)	3.689** (1.724)
High Productivity	0.046** (0.019)	0.069** (0.033)	0.045* (0.024)	0.095*** (0.026)	0.044** (0.018)	0.067** (0.033)	0.042* (0.023)	0.102*** (0.027)	-0.010 (0.025)	-0.008 (0.034)	0.003 (0.032)	-0.004 (0.042)
High Tech Manufacturing Offshoring	0.070 (0.111)	-0.129 (0.083)	-0.123 (0.054)	-0.197* (0.105)					-0.092 (1.390)	1.282 (3.814)	-1.158 (2.306)	0.823 (3.422)
Low Tech Manufacturing Offshoring	-0.013 (0.010)	-0.083 (0.220)	0.148 (0.148)	0.235 (0.178)					0.733 (1.390)	-3.863 (4.233)	1.210 (1.934)	0.720 (2.247)
Business Services Offshoring	0.177 (0.180)	-0.001 (0.020)	-0.019 (0.014)	-0.028 (0.016)					-0.536* (0.301)	0.507 (0.683)	-0.727 (0.506)	-1.469 (0.952)
High Tech Manuf Offshoring - Non-OECD					-0.369* (0.198)	-0.409 (0.414)	-1.049*** (0.277)	-1.393*** (0.479)				
High Tech Manuf Offshoring - OECD					0.016 (0.109)	-0.003 (0.183)	0.233* (0.133)	0.249 (0.251)				
Low Tech Manuf Offshoring - Non-OECD					-0.211 (0.437)	0.271 (0.753)	0.072 (0.518)	-0.561 (0.465)				
Low Tech Manuf Offshoring - OECD					0.176 (0.165)	-0.208 (0.333)	0.159 (0.214)	0.511* (0.269)				
Business Services Offshoring - Non-OECD					-0.096 (0.205)	-0.178 (0.249)	-0.075 (0.193)	-0.007 (0.220)				
Business Services Offshoring- OECD					0.019 (0.081)	0.067 (0.096)	0.003 (0.076)	-0.035 (0.090)				
High Prod*High Tech Offshoring	0.145 (0.093)	0.019 (0.221)	0.154 (0.160)	0.247 (0.202)					2.079 (1.346)	-3.337 (4.580)	4.478** (2.062)	1.875 (3.337)
High Prod*Low Tech Offshoring	-0.199*** (0.048)	-0.0592 (0.110)	-0.205*** (0.066)	-0.263*** (0.067)					-0.064 (1.724)	1.715 (2.869)	-2.284 (2.791)	-2.283 (2.815)
High Prod*Bus Svc Offshoring	-0.253 (0.158)	-0.189 (0.160)	-0.299* (0.153)	-0.268** (0.106)					0.168 (0.382)	0.681 (0.815)	-0.109 (0.550)	1.369* (0.780)
High Prod*High Tech Offshoring Non-OECD					0.297 (0.413)	0.374 (0.938)	-0.070 (0.750)	0.193 (1.157)				
High Prod*High Tech Offshoring OECD					0.099 (0.126)	-0.047 (0.335)	0.121 (0.162)	0.116 (0.298)				
High Prod*Low Tech Offshoring Non-OECD					0.163 (0.320)	0.133 (0.401)	0.138 (0.359)	0.279 (0.330)				
High Prod*Low Tech Offshoring OECD					-0.286*** (0.086)	-0.092 (0.159)	-0.280*** (0.102)	-0.417*** (0.115)				
High Prod*Bus Svc Offshoring Non-OECD					-0.025 (0.550)	-0.193 (0.690)	0.067 (0.542)	-0.414 (0.455)				
High Prod*Bus Svc Offshoring OECD					-0.313 (0.206)	-0.213 (0.220)	-0.370** (0.180)	-0.260* (0.155)				
Constant	-10.470 (1.504)	-7.496*** (0.408)	-9.478*** (0.289)	-8.729*** (0.344)	-10.410 (1.588)	-7.430*** (2.202)	-9.754*** (1.991)	-9.030*** (2.201)	-6.296*** (1.375)	-8.201*** (2.471)	-2.867 (2.096)	-6.312** (2.460)
Observations	516	513	513	513	516	513	513	513	367	363	363	363
R-squared	0.679	0.525	0.568	0.790	0.684	0.528	0.576	0.794	0.507	0.697	0.422	0.399
Number of countries_sectors	185	184	184	184	185	184	184	184	134	132	132	132

a) variables expressed in natural logs. Regressions include time and industry_country dummies. Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5 Regression Results with Policy Variables

	Manufacturing								Services							
	(1) Total Hours	(2) High Skill	(3) Medium Skill	(4) Low Skill	(5) Total Hours	(6) High Skill	(7) Medium Skill	(8) Low Skill	(9) Total Hours	(10) High Skill	(11) Medium Skill	(12) Low Skill	(13) Total Hours	(14) High Skill	(15) Medium Skill	(16) Low Skill
Relative Wages	-0.041 (0.033)	-0.081 (0.050)	-0.036 (0.039)	-0.029 (0.039)	-0.040 (0.031)	-0.081* (0.049)	-0.037 (0.038)	-0.014 (0.037)	-0.112*** (0.028)	-0.249*** (0.037)	-0.139*** (0.048)	-0.053 (0.070)	-0.107*** (0.028)	-0.251*** (0.039)	-0.133*** (0.051)	-0.036 (0.066)
Capital	0.363*** (0.069)	0.340*** (0.099)	0.498*** (0.085)	0.437*** (0.088)	0.403*** (0.070)	0.424*** (0.100)	0.543*** (0.088)	0.430*** (0.086)	0.338*** (0.066)	0.404*** (0.112)	0.321*** (0.089)	0.532*** (0.115)	0.333*** (0.065)	0.423*** (0.112)	0.311*** (0.089)	0.500*** (0.108)
Output	0.306*** (0.059)	0.240*** (0.077)	0.298*** (0.058)	0.273*** (0.068)	0.293*** (0.055)	0.227*** (0.072)	0.277*** (0.056)	0.282*** (0.062)	0.219*** (0.063)	0.373*** (0.079)	0.278*** (0.080)	0.131 (0.104)	0.219*** (0.063)	0.362*** (0.082)	0.276*** (0.080)	0.136 (0.100)
R&D Intensity	0.113 (0.189)	0.097 (0.414)	-0.040 (0.271)	0.087 (0.358)	0.013 (0.191)	-0.287 (0.375)	-0.097 (0.286)	0.082 (0.358)	0.988 (0.907)	1.086 (2.044)	0.963 (1.183)	3.848** (1.682)	0.281 (0.987)	1.227 (1.959)	0.116 (1.346)	1.743 (1.686)
Product Mkt Regulation (PMR)	-0.019 (0.020)	-0.047 (0.038)	-0.046 (0.032)	0.103*** (0.037)					0.002 (0.038)	-0.049 (0.048)	-0.025 (0.061)	0.106 (0.066)				
Employment Protection (EP)					-0.035 (0.026)	-0.158 (0.049)	0.003 (0.030)	-0.057 (0.050)					-0.011 (0.031)	0.061 (0.058)	-0.001 (0.033)	-0.109 (0.062)
High Tech Manufacturing Offshoring	-0.109* (0.065)	-0.131 (0.136)	-0.188** (0.094)	-0.163 (0.196)	-0.104 (0.127)	-0.069 (0.219)	-0.165 (0.177)	-0.368 (0.286)	2.413*** (0.579)	-0.948 (0.814)	3.358*** (0.901)	2.516*** (0.871)	10.110 (10.800)	28.920 (27.860)	10.880 (11.800)	25.210 (20.060)
Low Tech Manufacturing Offshoring	-0.144 (0.114)	-0.174 (0.168)	-0.099 (0.144)	0.081 (0.184)	-0.122 (0.150)	-0.226 (0.229)	0.003 (0.169)	0.043 (0.208)	0.886 (1.857)	-1.004 (2.585)	0.031 (2.833)	-1.666 (2.653)	0.561 (2.486)	-9.629 (8.202)	0.682 (2.638)	-5.395* (3.044)
Business Services Offshoring	-0.197 (0.119)	-0.195 (0.178)	-0.258** (0.104)	-0.085 (0.154)	-0.095 (0.131)	-0.102 (0.106)	-0.114 (0.143)	-0.078 (0.119)	-0.767** (0.298)	0.349 (0.628)	-1.266*** (0.404)	-1.429 (1.009)	-0.433 (0.358)	1.141 (1.162)	-0.493 (0.526)	-0.691 (0.731)
High PMR*High Tech Offshoring	0.013 (0.067)	-0.014 (0.146)	0.084 (0.093)	-0.051 (0.166)					7.505 (12.240)	20.170 (25.120)	11.050 (14.960)	2.188 (21.350)				
High PMR*LowTech Offshoring	-0.055 (0.073)	-0.084 (0.104)	0.060 (0.110)	-0.233** (0.113)					-2.420 (1.861)	-6.401 (5.652)	-1.992 (2.770)	-0.816 (3.506)				
High PMR*Bus Svc Offshoring	0.209* (0.119)	0.210 (0.176)	0.257** (0.101)	0.093 (0.154)					0.595** (0.287)	0.713 (0.636)	1.180*** (0.397)	0.733 (0.699)				
High EP*High Tech Offshoring					0.008 (0.068)	0.022 (0.112)	0.008 (0.095)	0.114 (0.126)					-8.291 (10.790)	-30.140 (28.030)	-8.235 (11.770)	-22.800 (19.950)
High EP*LowTech Offshoring					-0.049 (0.093)	0.008 (0.119)	-0.101 (0.094)	-0.094 (0.132)					-1.673 (2.579)	8.497 (8.025)	-2.713 (3.132)	2.751 (3.895)
High EP*Bus Svc Offshoring					0.105 (0.132)	0.113 (0.106)	0.118 (0.144)	0.077 (0.119)					-0.027 (0.340)	-0.650 (1.115)	-0.266 (0.459)	-0.590 (0.802)
Constant	-10.110 (1.530)	-5.523*** (2.099)	-9.155*** (1.926)	-8.218*** (2.115)	-10.780 (1.558)	-7.137*** (2.140)	-9.760*** (2.021)	-8.365*** (2.096)	-6.389*** (1.338)	-8.059*** (2.473)	-2.999 (2.016)	-7.228*** (2.492)	-6.288*** (1.351)	-8.321*** (2.424)	-2.752 (2.067)	-6.620*** (2.349)
Observations	516	513	513	513	516	513	513	513	367	363	363	363	367	363	363	363
R-squared	0.653	0.521	0.540	0.780	0.654	0.537	0.538	0.777	0.515	0.701	0.443	0.410	0.511	0.701	0.428	0.412
Number of countries sectors	185	184	184	184	185	184	184	184	134	132	132	132	134	132	132	132

a) variables expressed in natural logs. Regressions include time and industry dummies. Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6 Regression Results for Import Content of Exports^a

	Manufacturing Imports				Services Imports			
	(5) Total Hours	(6) High Skill	(7) Medium Skill	(8) Low Skill	(9) Total Hours	(10) High Skill	(11) Medium Skill	(12) Low Skill
Relative Wages	-0.0423 (0.0392)	-0.0963* (0.0534)	-0.0367 (0.0405)	-0.00466 (0.0442)	-0.0416 (0.0397)	-0.0924* (0.0536)	-0.0344 (0.0415)	-0.00282 (0.0450)
Capital	0.357*** (0.0546)	0.403*** (0.0763)	0.420*** (0.0636)	0.517*** (0.0678)	0.357*** (0.0547)	0.399*** (0.0753)	0.418*** (0.0642)	0.515*** (0.0688)
Output	0.313*** (0.0556)	0.331*** (0.0696)	0.308*** (0.0535)	0.272*** (0.0610)	0.313*** (0.0551)	0.337*** (0.0686)	0.305*** (0.0536)	0.266*** (0.0623)
R&D Intensity	-0.0879 (0.206)	0.117 (0.415)	-0.0983 (0.266)	-0.0399 (0.391)	-0.0797 (0.217)	-0.0614 (0.460)	-0.0752 (0.282)	0.0562 (0.405)
ImportContentExport_manufacturing	0.170 (0.258)	0.191 (0.420)	0.642** (0.288)	0.825** (0.343)				
ImportContentExport_service					0.153 (0.433)	2.259*** (0.807)	0.669 (0.655)	0.123 (1.245)
Constant	-10.15*** (1.314)	-9.001*** (1.833)	-7.631*** (1.556)	-10.70*** (1.669)	-10.12*** (1.284)	-9.114*** (1.774)	-7.462*** (1.550)	-10.43*** (1.670)
Observations	958	914	914	914	958	914	914	914
R-squared	0.467	0.539	0.417	0.621	0.467	0.548	0.413	0.618
Number of countries_sectors	348	331	331	331	348	331	331	331

a) variables expressed in natural logs. Regressions include time and industry dummies. Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

V. Conclusions and Policy Implications

In today's globalisation environment labour market effects of offshoring are most acutely felt in the high technology and business services, with little evidence of major impact from low technology industry offshoring. We find that the reductions in labour demand associated with high technology offshoring are countered by the positive impacts of this offshoring on services employment, with significant differences if the orders of magnitude implied by the coefficients.

We also see that high productivity growth sectors offshoring to other OECD economies are associated with lower unit labour demand (ie increases in productivity) in low technology and business services offshoring, with this same effect playing itself out in the offshoring of high technology jobs to non-OECD economies. While this could be an indication of an increase in the manufacturing sophistication in developing economies, the results for high productivity growth sectors seem to be felt especially by medium and low skilled workers.

Policies do seem to influence these outcomes. For instance, the fall in demand for workers from business services offshoring is lessened in an environment of high product market regulation, while it is increased for low skilled workers affected by low technology offshoring. Conversely, employment protection does not appear to have a major influence on offshoring's impact on labour demand.

Finally, ICE results provide strong support for the contention that integration into global production networks is good for employment. We find that the manufacturing import content of exports is positively and significantly associated with labour demand in medium and low skilled workers. Thus, one can infer that the negative association of manufacturing offshoring on medium and low skilled worker demand is a factor of increased efficiency, translated into cheaper inputs which in turn, expand exports and the demand for these workers domestically.

For policy makers these results imply that improving resource allocation should be the primary response to changes in labour demand as a result of integration into GVCs. While there are some negative outcomes associated with offshoring, there are many, sometimes larger, positive impacts. The ICE results show explicitly that positive effect associated with the integration into global production networks. Thus access to international markets should remain a policy priority as should putting programs in place that identify and assist those unemployed due to the structural changes brought about by new global production patterns.

REFERENCES

- A. T. Kearney (2011), *Offshoring Opportunities Amid Economic Turbulence*.
- Acemoglu, D. and D. Autor (2010), "Skills, Tasks and Technologies: Implications for Employment and Earnings", *NBER Working Papers*, No. 16082, National Bureau of Economic Research.
- Amiti, M. and S. Wei (2006), "Service Offshoring, Productivity and Employment: Evidence from the US", *CEPR Discussion Paper* No. 5475, February.
- Baldwin R. and A. Venables (2010), "Relocating the Value Chain: Offshoring and Agglomeration in the Global Economy", *NBER Working Papers*, No. 16"611, National Bureau of Economic Research.
- Beltramello, S., K. De Backer, and L. Moussiégt (2012), "The Export Performance of Countries with Global Value Chains (GVCs), *OECD Science , Technology and Industry Working Papers*, 2012/02, OECD Publishing, <http://dx.doi.org/10.1787/5k9bh3gv6647-en>.
- Bernard B. A. and J. B. Jensen (2004), "Why Some Firms Export", *Review of Economics and Statistics* 86, pp. 561-569.
- Blinder, A. (2009), "How Many US Jobs Might be Offshorable?" *World Economics*, 10, 41-78.
- Campa, J. and L.S. Goldberg (1997), "The Evolving External Orientation of Manufacturing Industries: Evidence from Four Countries", *NBER Working Paper* 5919, National Bureau of Economic Research.
- Carneiro F.G. and J.S. Arbache (2003), "The Impact of Trade Liberalisation on the Brazilian Labour Market: A CGE Model Approach", *World Development*, Vol. 31, No. 9, pp 1581-1595.
- Chen, H., M. Kondratowicz, and K.M. Yi (2005), "Vertical Specialization and Three facts about U.S. International Trade", *North American Journal of Economics and Finance*, 16, pp. 33-59.
- Crinò, R. (2010), "Service Offshoring and the Skill Composition of Labour Demand," *Oxford Bulletin of Economics and Statistics*, 74(1), pp. 20-57.
- Davidson C. and S. Matusz (2000), "Globalization and Labour Market Adjustment: How Fast and at What Cost?" *Oxford Review of Economic Policy*, 16(3), pp. 42-56.
- DeBacker K., and N. Yamano (2008), "The Measurement of Globalisation Using International Input-Output Tables", *STI Working Paper 2007/08*, OECD.
- European Economic Advisory Group 2005, "Chapter 2: Outsourcing", *Report on the European Economy*, Cesifo (eds).
- Feenstra, R. and G. Hanson (1996), "Globalisation Outsourcing, and Wage Inequality", *American Economic Review*, Vol. 86, pp. 240-245.

- Feenstra, R. and G. Hanson (1999), "Productivity Measurement and the Impact of Trade and Technology on Wages: Estimates for the U.S., 1972-1990", *Quarterly Journal of Economics*, Vol. 114, No. 3, pp. 907-940.
- Feenstra, R., G. Hanson, and S. Lin (2002), "The Value of Information in International Trade: Gains to Outsourcing through Hong Kong", NBER Working Paper no. 932.
- Gereffi, G (2006), "The New Offshoring of Jobs and Global Development", *ILO Social Policy Lectures*, Jamaica, December 2005.
- Gereffi, G., Humphrey, J., Sturgeon, T. (2005), "The governance of global value chains", *Review of International Political Economy*, 12(1), pp. 78–104.
- Gonzales, F., J.B Jensen, Y. Kim and H.K. Nordas (2012), "Globalisation of Services and Jobs", in *Policy Priorities for International Trade and Jobs*, ed.: D. Lippoldt, OECD, *forthcoming*.
- Goos, M., A. Manning, and A. Salomons, (2009), "Job Polarisation in Europe" *American Economic Review: Papers and Proceedings*, 99(2), pp.58-63.
- Görg, H. and A. Hanley (2009), "Services Outsourcing and Innovation: An Empirical Investigation", CEPR Discussion Paper No. 7390.
- Hijzen, A. and P. Swaim (2007), "Does Offshoring Reduce Industry Employment", *National Institute Economic Review*, No. 201, July.
- Hill, S., M. Leshner and H. Nordas (2008), "Trade and Labour Market Adjustments", [TAD/TC/WP\(2007\)7/FINAL](#).
- Horgos, D. (2009), 2009. "Labor Market Effects of International Outsourcing: How Measurement Matters," *International Review of Economics & Finance*, Elsevier, vol. 18(4), pages 611-623.
- Hummels, D. Rapoport D., and Yi, K. (1998), "Vertical Specialization and the Changing Nature of World Trade", *Economic Policy Reviews*, June, pp. 79-98.
- Hummels, D., J. Ishii, and K. Yi (2001), "The Nature and Growth of Vertical Specialisation in World Trade", *Journal of International Economics*, Vol. 54, pp. 75-96.
- Jones, R. and H. Kierzkowski (1990), "The Role of Services in Production and International Trade: A Theoretical Framework" in *The Political Economy of International Trade*, eds. Ronald W. Jones and Anne O. Krueger, Basil Blackwell, Oxford, UK.
- Lanz, R. S. Miroudot, and H. Nordas, (2010), "Trade in Tasks", *Trade Policy Working Paper Number 117*, OECD.
- Manning, S., S. Massini and A. Lewin (2008), "A Dynamic Perspective on Next-Generation Offshoring: The Global Sourcing of Science and Engineering Talent", *Academy of Management Perspectives*, August, pp. 35-54.
- Melitz, M.J. (2003), "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity", *Econometrica*, Vol. 71, No. 6.
- Moran, T. (2002), "Strategy and Tactics for the Doha Round, Capturing the Benefits of Foreign Direct Investment", Asian Development Bank, Manila.
- Newfarmer, R. and M. Sztajerowska (2012), "Trade and Employment in a Fast-Changing World", in *Policy Priorities For International Trade and Jobs*, ed.: D. Lippoldt, OECD, *forthcoming*.
- OECD (2001), *New Patterns of Industrial Globalisation*, OECD, Paris.
- _____ (2007), *OECD Employment Outlook 2007*, Paris.

- _____ (2011a), “Revisiting Trade in a Globalised World: Current and Future Work on Measuring Trade in Value-Added Terms”, [TAD/TC/WP\(2011\)26](#), 2007, Paris.
- _____ (2011b), Product Market Regulation Database, www.oecd.org/economy/pmr.
- OECD, ILO, World Bank and WTO (2010), “Seizing the Benefits of Trade for Employment and Growth” prepared for the G20 Summit, Korea.
- Stone, S. and B. Shepherd (2010), “Dynamic Gains from Trade: The Role of Intermediate Inputs and Equipment Imports”, [TAD/TC/WP\(2010\)15/REV1](#).
- Yeats, A.J. (2001), “Just How Big is Global Production Sharing?” in S.W. Arndt and H. Kierzkowski (eds), *Fragmentation, New Production Patterns in the World Economy*, pp. 108-143.
- Zhu, S., N. Yamano and A. Cimper (2011), “Compilation of Bilateral Trade Database by Industry and End-Use Category”, <http://www.oecd.org/dataoecd/44/55/49319940.pdf?contentId=49319925> [DSTI/DOC\(2011\)6](#).

DATA ANNEX

1. The data for imports, exports, value added, gross output and employee compensation are taken from the OECD Input-Output tables. Price indices for output and materials by sector are taken from STAN. For observations for which information on the volume of materials was not available, the volume of materials was imputed by dividing the current value of materials, if available, or otherwise the difference between the current value of output and value-added, by the price index of materials.
2. For observations for which information on the price of materials was not available, the price of materials was imputed using the input-output tables. The price index of materials was imputed by multiplying the share of total purchases (domestic plus imported) by industry i from supplying industry j in total intermediate purchases (domestic plus imported) by industry i with the price of value-added of industry j . For the panel data analysis this involves making the assumption that the composition of inputs is fixed over time and corresponds to that in 2000.
3. For observations for which information on the volume of output was not available, the volume of output was imputed by adding the volume of materials and the volume of value-added (see for more details the price of materials). For observations for which information on the price of output was not available, the price of output was imputed by taking the sum of the share of value-added in output times the price of value-added and the share of materials in output times the price of materials.
4. Data for capital by sector and total employment are generally based on STAN. For those countries with little or no information in STAN, we replace supplement using data from EU KLEMS (after having harmonised to the OECD Input-Output sector classification). R&D expenditure data are from OECD Analytical Business Enterprise Research and Development (ANBERD) database.
5. Data on the breakdown of OECD and non-OECD imported intermediate inputs comes from the STAN Bilateral Trade Database by Industry and End-use category (BTDIxE) which breaks down the values of imports and exports of both by industrial sectors and by end-use categories. BTDIxE has been designed to extend the 'traditional' BTD database and allows, for example, insights into the patterns of trade in intermediate goods between countries to track global production networks and supply chains and it helps to address policy issues such as trade in value added and trade in tasks.
6. In this first version of BTDIxE, estimates of imports and exports of goods are presented for the period 1995-2010 (or latest available year) and for 64 reporters: all OECD Member Countries and 30 non member economies, notably the BRIICS (Brazil, the Russian Federation, India, Indonesia, China and South Africa). It should be noted that underlying series for OECD countries are from OECD International Trade by Commodity Statistics., while data for non OECD economies come from UNSD database COMTRADE. The list of partners in BTDIxE covers all 34 OECD countries, 30 non member economies, the Rest of world, the partner Unspecified, and the Total World. Trade flows are divided into 46 economic activities and 9 categories including capital goods, intermediate goods and household consumption.
7. Hours worked and compensation data for high-medium and low skills are from EU KLEM 2008. Since data are reported as percentage by gender and age cohort in each skill group, the data were first aggregated by skill and the aggregated share was then multiplied by the total hours worked by employees and compensation by employee to get the total hours worked and compensation for each skill category.

8. TFP growth rate data are also from EU KLEM. TFP (value added based) growth is computed as an index using 1995 as base.

9. Table A1 contains a list of countries with information on total employment and the number of sectors covered for each of the three time periods.

Table A1 Country/Sector coverage of Employment

Country	1995	2000	2005	Country	1995	2000	2005
Australia	28	28	28	Korea	24	24	24
Austria	28	28	28	Luxembourg	26	26	28
Belgium	28	28	28	Mexico	11	11	11
Canada	28	28	28	Netherlands	28	28	28
Czech Republic	28	28	28	New Zealand	24	24	28
Denmark	28	28	28	Norway	26	26	26
Estonia	28	28	28	Poland	24	24	24
Finland	28	28	28	Portugal	28	28	28
France	27	27	27	Slovak Republic	28	28	28
Germany	28	28	28	Slovenia	28	28	28
Greece	28	28	28	Spain	28	28	28
Hungary	28	28	28	Sweden	28	28	28
Ireland	28	28	28	Switzerland	28	28	28
Israel	10	10	10	United Kingdom	24	24	24
Italy	28	28	28	United States	28	28	28
Japan	28	28	28				