Offshoring, Inshoring and Labour Market Volatility[#]

(Suggested Running Title: Offshoring, Inshoring and Volatility)

Neil Foster-McGregor

UNU-MERIT, Keizer-Karelplein 19, 6211TC, Maastricht, The Netherlands. Email:

foster@merit.unu.edu

Johannes Pöschl

Vienna Institute for International Economic Studies (wiiw), Rahlgasse 3, 1060, Vienna, Austria.

Email: johannes.poeschl@wiiw.ac.at

[#] The authors gratefully acknowledge financial support from the Jubiläumsfonds of the Austrian National Bank (OeNB). Comments from participants at the joint CESSA-wiiw workshop held in Vienna in June 2013 and an anonymous referee are gratefully acknowledged.

Abstract

Using sectoral data from the World Input Output Database this paper considers the impact of offshoring and inshoring on the volatility of employment and wage growth. Our results indicate that inshoring has a positive impact on sectoral employment volatility, while offshoring has a negative impact. Additional results indicate that much of the positive volatility effect of inshoring is found to occur in countries in East Asia and the EU12, regions that are important destinations for offshoring activities. Conversely, the negative volatility effect of offshoring is found to occur mainly in EU15 and Other countries, which consists of developed countries that are relatively intensive offshorers. We also present results to suggest that firms smooth employment fluctuations by offshoring, and that such smoothing tends to be concentrated upon low- and medium-educated workers.

Keywords: Offshoring, Inshoring, Volatility, Employment, Wages

JEL Codes: F1, F4,

1. Introduction

A number of studies have linked trade openness to the volatility of output (e.g. Haddad et al, 2013), with di Giovanni and Levchenko (2009) recently finding that openness has a positive and economically significant impact on the volatility of output per worker growth in a large cross-section of countries.[i] The presence of such a relationship is important because studies have found that increased volatility is associated with lower long-run growth (Ramey and Ramey, 1995) and welfare (Pallage and Robe, 2003), as well as having effects on inequality and poverty (Laursen and Mahajan, 2005). Theoretically, the argument for a role of openness in affecting volatility is weak, with little understanding of the channels through which the effect works. Di Giovanni and Levchenko (2009) discuss a number of channels including the argument that trade exposes a country or industry to external shocks, changes the degree of co-movement between the trading industries and the rest of the economy, and impacts upon the diversification of production across sectors. In this paper, we consider the impact of offshoring and inshoring on volatility, and also the impact of offshoring and inshoring on the volatility of employment and wage growth.

The ongoing globalisation process has seen the increasing frequency of international outsourcing – or offshoring – of production, involving the contracting out of activities that were previously performed within a production unit to foreign subcontractors. Discussion of the impacts of offshoring tends to be focussed on labour markets, in terms of its links to changes in employment, wage levels and relative wages (see for example, Feenstra and Hanson, 1999; Foster-McGregor et al, 2013).

In this paper we move away from this focus on the impact of offshoring on absolute and relative wages and employment, to consider its impact on labour market volatility. The expansion in offshoring helps tie industries in different countries to each other, and this can lead to increased volatility at the sector and macro level. Such increased volatility may be linked to a number of labour market phenomena that have been noticed in recent years. For example, increased

volatility in labour markets may be an explanation for the increased vulnerability felt by workers (Alibert et al, 2006), the reduced bargaining power of workers (IMF, 2007), and the reduced opportunities for risk-sharing arrangements between workers and firms (Bertrand, 2004).

Empirically, a small number of papers have presented evidence to suggest that offshoring may be a determinant of sectoral volatility. Bergin et al (2009), for example, note that employment fluctuations in Mexican maquiladora industries are twice as volatile as those in their US counterparts, while Comin et al (2009) show that although the recent recession in Mexico started later than that in the US, it was much more severe. Bergin et al (2011) develop a model of global production sharing in which the decisions of firms respond to macroeconomic shocks. An important feature of the model is that the decision to offshore by firms in the home market is endogenously determined by comparing home and foreign unit labour costs. Since home wages are pro-cyclical a boom in demand will tend to increase the extent of offshoring, with the higher wages in the home country making it profitable for more firms to offshore production. The reverse will occur in the case of a negative demand shock. The implication of this is that shocks in the offshoring country will tend to be amplified in their transmission abroad. Bergin et al (2011) identify two main reasons for this amplification effect. Firstly, in their example of the Mexican maquiladora sector, the foreign offshoring sector has smaller total employment than in the home country. Any given shift in employment from the home to the foreign country (or vice versa) will have a bigger impact on volatility in the foreign countries therefore. Secondly, the direct effect of a demand increase on employment in the home country will be offset by the indirect decrease in demand due to greater offshoring. In the case of the foreign offshoring country however, the sole effect of the demand shock will be via the offshoring channel. Using a calibration exercise Bergin et al (2011) find in the case of the US and Mexico that their model fits the data well, with the results predicting a high degree of volatility in the Mexican offshoring sector relative to the Mexican economy as a whole and relative to the US offshoring sector.

In our analysis we use the recently compiled World Input Output Database (WIOD) to consider the impact of indicators of offshoring and inshoring on volatility. Consistent with Bergin et al (2011) we measure volatility using a measure of the volatility of employment growth, but also report results using a measure of the volatility of wage growth. Based on WIOD, we then construct measures of offshoring, consistent with those used elsewhere in the literature (e.g. Feenstra and Hanson, 1999; Hijzen and Swaim, 2010). In addition, we consider the flip-side of offshoring, what others have termed inshoring (see for example Liu and Trefler, 2008). Inshoring refers to intermediates sourced from the country of interest by other countries, such that if offshoring involves importing intermediates from other countries, inshoring involves the export of intermediates to other countries. This is relevant, since the model of Bergin et al (2011) suggests that it is industries that inshore intensively that should suffer from increased employment volatility, with the effects in offshoring intensive industries being muted.

Using data for up to 38 countries and 15 sectors over the period 1995-2009 we find that inshoring has a positive impact on sectoral employment volatility, while offshoring has a negative impact, an outcome consistent with Bergin et al (2011). Additional results indicate that much of the positive volatility effect of inshoring is found to occur in countries in East Asia and the EU12, regions that are important destinations for offshoring activities. Conversely, the negative volatility effect of offshoring is found to occur mainly in EU15 and Other countries, i.e. a set of developed countries that are relatively intensive offshorers. We also present results to suggest that firms smooth employment fluctuations by offshoring, and that such smoothing tends to be concentrated upon low- and medium-educated workers.

The remainder of the paper is organized as follows: Section 2 describes the methodology and the construction of the various inshoring and offshoring indices: Section 3 describes our main results; and Section 4 provides the policy conclusion.

2. Methodology and Data Construction

The starting point for our analysis is the simple regression model:

$$\ln volatility_{ic} = \alpha_0 + \alpha_1 x_{ic} + \alpha_2 \ln offshoring_{ic} + \alpha_3 \ln inshoring_{ic} + \gamma_i + \delta_c + \varepsilon_{ic} \quad (1)$$

where $volatility_{ic}$ is the variance of either employment growth or wage growth in sector i in country c based on data over the period 1995-2009, $offshoring$ and $inshoring$ are the variables of offshoring and inshoring respectively, x is a set of additional explanatory variables, and γ_i and δ_c are sector and country fixed effects respectively. The variance of employment growth is constructed using data on the number of employees[ii], while the variance of wage growth is constructed using data on average wages (i.e. the ratio of labour compensation to the number of employees).

The additional variables included in the above regression are a measure of either initial employment or initial average wages, and a general trade openness variable. We may expect that the dependent variable in the above equation is affected by trade phenomena other than offshoring. Since these are likely to be correlated with offshoring we have a potential omitted variable bias problem. To control for this, in additional specifications we add a general trade openness measure to the above regressions. In particular, we follow the approach of di Giovanni and Levchenko (2009) by including the log of the ratio of imports plus exports to value added in the regression models. The inclusion of this variable further allows us to test the robustness of our results to the inclusion of a general openness measure.

The basic data source for our analysis is the recently compiled WIOD, which reports data on socio-economic accounts, international input-output tables and bilateral trade data across 35 industries and 40 countries over the period 1995-2009.[iii] These data result from an effort to bring together information from national accounts statistics, supply and use tables, data on trade in goods and services and corresponding data on factors of production (capital and labour by educational attainment categories). The starting point for the WIOD data are national supply and use tables (SUTs) which have been collected, harmonized and standardized for 40 countries (the 27 EU countries, Australia, Brazil, Canada, China, India, Indonesia, Japan, Korea, Mexico,

Russia, Taiwan, Turkey and the US) over the period 1995-2009. These tables contain information on the supply and use of 59 products in 35 industries together with information on final use (consumption, investment) by product, value added and gross output by industry and have been benchmarked to time series of national accounts data on value added and gross output to allow for consistency over time and across countries. This approach allows one to provide information on supply and use of products by industry for each country. Using detailed trade data the use tables are then split up into domestic and imported sourcing components, with the latter further split by country of origin. Data on goods trade were collected from the UN COMTRADE database at the HS 6-digit level. These detailed bilateral trade data allow one to differentiate imports by use categories (intermediates, consumption and investment goods) by applying a modified categorisation based on broad end-use categories at the product classification. Bilateral trade in services data were collected from various sources. Services trade data are only available from Balance of Payments (BoP) statistics providing information at a detailed level only in BoP categories. Using a correspondence these data were merged to the product level data provided in the supply and use tables. The differentiation into use categories of services imports was based on information from existing import use or import input-output tables. Combining this information from the bilateral trade data by product and use categories with the supply and use tables resulted in a set of 40 international use tables for each year. This set of international supply and use tables was then transformed into an international input-output table using standard procedures (model D in the Eurostat manual (Eurostat, 2008)). A rest-of-the-world was also estimated using available statistics from the UN and included in this table to account for world trade and production. This results in a world input-output database for 41 countries (including the rest-of-the-world) and 35 industries. Additional data from the socio-economic accounts allow for the splitting up of value added into capital and labour income and the latter into low, medium and high educated workers. These data are available both in factor income and physical input terms, which allow us to calculate employment and average

wages, and in turn employment and wage growth. In particular, we use information on the number of employees as our indicator of employment, and the ratio of labour compensation to employment as our indicator of (average) wages.

When measuring offshoring the majority of existing studies focus on some measure of trade in intermediates, though it is acknowledged that this ignores the offshoring of assembly activities. In our analysis we use data from input-output tables, which allow us to measure the intermediate input purchases by each industry from each industry. In terms of the measures of offshoring Feenstra and Hanson (1999) distinguish between narrow and broad offshoring, where the former considers imported intermediates in a given industry from the same industry only, while the latter considers imported intermediates from all other industries. Feenstra and Hanson (1999) prefer the narrow definition as it is thought to be closer to the essence of fragmentation, which necessarily takes place within the industry.[iv] In our analysis we will consider both narrow and broad measures of both offshoring and inshoring. Our narrow measures of offshoring and inshoring are defined as:

$$OFF_i^N = \frac{O_{ii}}{va_i} \tag{2}$$

$$IN_i^N = \frac{I_{ii}}{va_i} \tag{3}$$

where O_{ii} refers to imported intermediates from industry i by industry i, I_{ii} refers to exported intermediates from industry i to industry i, and va refers to value-added. Similarly, our broad offshoring and inshoring measures are defined as:

$$OFF_i^B = \frac{\sum_{k=1,k\neq i}^{K} O_{ik}}{va_i} \tag{4}$$

$$IN_i^B = \frac{\sum_{k=1,k\neq i}^{K} I_{ik}}{va_i} \tag{5}$$

In our analysis we use data on 38 countries[v] and 15 (mainly manufacturing) sectors.[vi] The industries that are excluded are largely non-market services where offshoring is less likely to be a

significant activity.[vii] In our analysis we use the values of these measures from the initial period in the dataset (i.e. 1995), which helps eliminate endogeneity that may arise due to factors that affect both openness within a sector and volatility simultaneously.[viii]

Tables A2 and A3 in the appendix report the mean values of the variance of wage and employment growth along with the average values of the narrow and broad inshoring and offshoring measures by country and sector respectively. These tables tend to indicate that volatility of both wages and employment is often found to be relatively large in a number of East European countries (e.g. Hungary, Estonia, Bulgaria, Lithuania and Romania) as well as countries such as Turkey and Indonesia. Volatility is also found to be larger in the food, textiles and agriculture sectors compared with other manufacturing sectors.

4. Results

4.1. Linear Results

Tables 1A and 1B report results when using the narrow measures of offshoring and inshoring, with Table 1B including the general trade openness variable. The first three columns report results when the dependent variable is employment volatility and the final three columns report impacts on wage volatility. The results for employment volatility indicate that narrow inshoring tends to increase employment volatility, while narrow offshoring tends to reduce it. The coefficients on the offshoring variable become insignificant when a general trade measure is included, but those on the inshoring variable remain significant and increase in size. The coefficient on the trade variable itself is negative, though usually insignificant. Initial employment is found to have a negative impact on employment volatility. The coefficients on the narrow inshoring variable suggest that a one standard deviation increase in narrow inshoring is associated with an increase in employment volatility of between 0.08 and 0.13 standard deviations. A similar increase in narrow offshoring is associated with a decrease in employment volatility of between -0.083 and -0.086 standard deviations.

When considering wage volatility we find insignificant coefficients on the offshoring and inshoring variables in the top half of the table. When including the trade variable in the bottom half of the table we find negative and significant coefficients on both the inshoring and offshoring variables. The coefficients on the trade variable are found to be positive and significant, as are the coefficients on the initial wage trade variable. A one standard deviation in inshoring (offshoring) is associated with a decrease in wage volatility of between 0.094 and 0.102 (0.072 and 0.081) standard deviations.

Tables 2A and 2B report similar results to tables 1A and 1B, but use the broad measures of inshoring and offshoring. When considering employment volatility we find coefficients on the inshoring and offshoring variables that are consistent with the results using the narrow measure. In particular, we find positive coefficients on the inshoring variable and negative coefficients on the offshoring variable. Coefficients on the offshoring variable are generally significant, while those on the inshoring variable tend to be insignificant. A one standard deviation in the broad offshoring measure is associated with a decrease in employment volatility by between 0.125 and 0.139 standard deviations. When considering wage volatility we again find insignificant coefficients on the offshoring and inshoring variables in the top half of the table. When including the trade variable however, we find that inshoring is associated with lower wage volatility. A one standard deviation increase in broad inshoring is associated with a decrease in wage volatility of 0.088 standard deviations.

4.2. Employment Volatility by Type

The results presented above in Section 4.1 suggest that inshoring – and narrow inshoring in particular – is associated with increased employment volatility, while offshoring is associated with reduced employment volatility. These results are consistent with results presented by Bergin et al (2011), who found that the volatility of employment growth was higher in inshoring rather than offshoring industries. In this subsection, we extend the analysis to examine whether the

association between inshoring, offshoring and employment volatility differs across employment types. In particular, we calculate the volatility of employment growth for low-, medium-, and high-educated workers separately and in turn estimate our regression model for each type of labour. The data on low, medium and high educated workers are constructed based upon the 1997 International Standard Classification of Education (ISCED), with ISCED levels 1 and 2 being classified as low educated workers, ISCED levels 3 and 4 being classified as medium educated and ISCED levels 5 and 6 being classified as high educated workers.

Results are reported in Tables 3A and B, 4A and B, and 5A and B for low-, medium- and high-educated workers respectively, where the measure of employment in each table refers to employment of the appropriate education level. The tables indicate that the measures of inshoring are never found to be significant, though the coefficients are usually positive. The one exception is when considering narrow inshoring and the volatility of medium educated employment, where a positive and significant coefficient is found. Turning to the coefficients on the offshoring variables we again find no significant coefficients when considering the volatility of high-skilled employment, but we do find negative coefficients for both low- and medium-skilled employment, that are often significant. The results thus imply that the lower employment growth volatility associated with offshoring falls largely on low- and to a lesser extent medium-educated workers. This further implies that much of the employment smoothing undertaken by firms through offshoring involves the smoothing of low- and medium-educated employment.

4.3. Regional Results

In this final results section we examine whether there are differences in the impact of offshoring and inshoring across regions. To do this, we split our sample into four groups: EU15, EU12, East Asia and Other[ix] and examine whether the coefficients on the offshoring and inshoring variables differs across these samples by including an interaction between the offshoring and

inshoring measures and each of the regional dummies. Tables 6 and 7 report results for employment volatility when considering the narrow and broad measures of offshoring and inshoring respectively.[x]

The results in Table 6 indicate that narrow inshoring has a positive and significant coefficient in the case of East Asia only. When including the general trade variable, positive and significant coefficients are also consistently found in the case of the EU12, with significant coefficients also found for the EU15 and the Other group in one case. When looking at the offshoring variable we find negative coefficients in all cases and for all regions, but the coefficients are only consistently significant in the case of Other countries, a group which includes the developed and intensive offshoring countries Canada and the USA, as well as offshoring destination countries Mexico and India.

Results in Table 7 using the broad measures of offshoring and inshoring are fairly similar to those using the narrow measure. In particular, we find a positive coefficient on the inshoring variable for East Asia that is usually significant, while coefficients for the other regions are usually insignificant. In the case of broad offshoring we find consistently negative and significant coefficients in the case of Other countries and the EU15, with coefficients for EU12 and Asia found to be insignificant.

In general, these results would seem to provide some support to the view that the positive impact of narrow inshoring on employment volatility is to a large extent concentrated in countries in East Asia and EU12, countries that are often considered to be the main destinations for offshoring activities. In contrast, the negative effects of offshoring on employment volatility tend to be found in the EU15 and Other regions, groups which include mainly developed and offshoring intensive countries.

5. Conclusions

In this paper we consider the impact of inshoring and offshoring activities on the volatility of both employment and wage growth. Existing literature suggests that indicators of openness can impact upon volatility, which in turn can have a number of other macroeconomic effects on a country. To date there has been little research on the effects of a particular form of trade openness – namely offshoring and inshoring – on volatility, despite a wealth of evidence on other impacts of offshoring, particularly its impact on labour markets.

Using the recently compiled WIOD we examine the impact of inshoring and offshoring on sectoral volatility. Our results indicate that inshoring has a positive impact on sectoral employment volatility, while offshoring has a negative impact. These results are consistent with other (case study type) evidence of the USA and Mexico, where offshoring by the US to Mexico is found to reduce employment volatility in the USA, but increase it in Mexico. Our results thus suggest that this pattern is applicable more widely. Additional results provide further support for this pattern. In particular, additional results indicate that much of the positive volatility effect of inshoring is found to occur in countries in East Asia and the EU12, regions that are important destinations for offshoring activities. Conversely, the negative volatility effect of offshoring is found to occur mainly in EU15 and Other countries (a group which includes the USA and Canada), that is a set of developed countries that are relatively intensive offshorers. One major reason for this finding is likely the fact that workers are less protected by labour market regulations in many EU12 as well as East Asian countries compared to EU15 or even Latin American countries. Thus, if firms in developed countries offshore to these regions they not only offshore more labour intensive tasks due to differences in wages but likely also more volatile parts of the production because it is easier to lay off workers. In case of a shock, this additionally aggravates the inshoring effect described by Bergin et al (2011). Thus it is the responsibility of policy makers in East Asian as well as EU12 countries to find a level of labour market regulation which leads to a socially acceptable level of volatility.

Engagement in Global Value Chains is the primary means through which many developing countries around the world, but in East Asia and the EU12 in particular, engage in international trade. These regions have benefitted greatly in terms of employment from these activities, but the results in this paper suggest that the current pattern of offshoring is likely to increase employment volatility in these regions. Since the extent of inshoring by East Asia and the EU12 is likely to depend upon economic performance in offshoring countries, we would expect that employment volatility in East Asia and the EU12 would depend upon economic performance in the offshoring countries. In order to smooth employment in the main inshoring countries, a further aim of policy should be to diversify inshoring activities both across offshoring partners and sectors therefore, with the eventual aim of shifting from inshoring to offshoring activities.

[i] Recent work also considers the relationship between openness and volatility at the firm-level, with Buch et al (2006) finding that German firms that export are less volatile than non-exporters for example.

[ii] Results when constructing volatility based on hours worked are qualitatively similar, and are available upon request.

[iii] For a detailed presentation of the database see Timmer (2012).

[iv] Hijzen et al (2005) note that this distinction is not without problems, most notably due to the way industries are defined in the data. They consider the example of two industries in which outsourcing is important, namely 'motor vehicles and parts' and 'textiles', noting that while 'motor vehicles and parts' is a single industry in the UK IO table, 'textiles' consists of up to ten industries.

[v] The 38 countries are: Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, India, Indonesia, Ireland, Italy, Japan, Korea, Lithuania, Luxembourg, Latvia, Mexico, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Turkey, Taiwan, the United Kingdom, and the United States of America.

[vi] The sectors included are: Agriculture, Hunting, Forestry and Fishing; Mining and Quarrying; Food, Beverages and Tobacco; Textiles and Textile Products; Leather, Leather and Footwear; Wood and Products of Wood and Cork; Pulp, Paper, Paper , Printing and Publishing; Coke, Chemicals and Chemical Products; Rubbers and Plastics; Other Non-Metallic Mineral; Basic Metals and Other Fabricated Metal; Machinery, Nec; Electrical and Optical Equipment; Transport Equipment; and Manufacturing, Nec; Recycling.

[vii] Note that while these sectors are dropped from the regression analysis all sectors and countries (including the rest of the world) in WIOD are used when calculating the inshoring and offshoring measures.

[viii] The use of industry and country fixed effects will also help eliminate endogeneity problems, with the country fixed effects removing any unobserved country-specific characteristics (e.g. geographical and population features, institutions, and so on), while industry fixed effects will control for any industry-specific characteristics (such as those related to technology, external finance reliance, and so on).

[ix] The East Asia group comprises China, Indonesia, Japan, Korea and Taiwan. The other group is a rather heterogeneous group and includes Australia, Brazil, Canada, India, Mexico, Turkey and the USA.

[x] For brevity we concentrate on the results for employment volatility. Results when considering wage volatility are in general less often significant. These results are available on request.

References

Bergin, P.R., Feenstra, R.C. and G.H. Hanson, 2009. Offshoring and Volatility: Evidence from Mexico's Maquiladora Industry. *American Economic Review*, **99**, 1664-1671.

Bergin, P.R., Feenstra, R.C. and G.H. Hanson, 2011. Volatility due to Offshoring: Theory and Evidence. *Journal of International Economics*, **85**, 163-173.

Buch, C., Döpke, J. and H. Strotmann, 2006. Does Export Openness Increase Firm-Level Volatility? University of Tübingen and Deutsche Bundesbank, Mimeo.

Comin, D., Loayza, N., Pasha, F. and L. Serven, 2009. Medium Term Business Cycles in Developing Countries. NBER Working Paper no 15428, National Bureau of Economic Research.

Feenstra, R.C. and G.H. Hanson, 1999. The Impact of Outsourcing and High-Technology Capital on Wages: Estimates for the United States, 1979-1990. *Quarterly Journal of Economics*, **114**, 907-941.

Foster-McGregor, N., Stehrer, R. and G. de Vries, 2013. Offshoring and the Skill Structure of Labour Demand. *Review of World Economics*, **149**, 631-662.

di Giovanni, J. and A.A. Levchenko, 2009. Trade Openness and Volatility. *Review of Economics and Statistics*, **91**, 558-585.

Haddad, M., Lim, J.J., Pancaro, C. and C. Saborowski, 2013. Trade Openness Reduces Growth Volatility when Countries are well Diversified. *Canadian Journal of Economics*, **46**, 765-790.

Hijzen. A., Görg, H. and R.C. Hine, 2005. International Outsourcing and the Skill Structure of Labour Demand in the United Kingdom. *Economic Journal*, **115**, 860-878.

Hijzen, A. and P. Swaim, 2010. Offshoring, Labour Market Institutions and the Elasticity of Labour Demand. *European Economic Review*, **54**, 1016-1034.

International Monetary Fund, 2007. *World Economic Outlook*. The IMF, Washington, DC.

Laursen, T. and S. Mahajan, 2005. Volatility, Income Distribution and Poverty. *Managing Economic Volatility and Crises: A Practitioner's Guide* (eds. Aizenman, J. and Pinto, B.), Cambridge University Press, New York, pp 101-136.

Liu, R. and D. Trefler, 2008. Much ado about Nothing: American Jobs and the Rise of Service Outsourcing to China and India. NBER Working Paper no. 14061, National Bureau of Economic Research.

Pallage, S. and M.A. Robe, 2003. On the Welfare Cost of Economic Fluctuations in Developing Countries. *International Economic Review*, **44**, 677-698.

Ramey, G. and V.A. Ramey, 1995. Cross-Country Evidence on the Link between Volatility and Growth. *American Economic Review*, **85**, 1138-1151.

Timmer, M., P, (ed.) 2012. The World Input-Output Database (WIOD): Contents, sources and methods. WIOD Working Paper no. 10 (available online at www.wiod.org).

Appendix

Table A1: Industries and Industry Classification

Code	Industry	Type
AtB	Agriculture, Hunting, Forestry and Fishing	M/Low
C	Mining and Quarrying	M/Med
15t16	Food, Beverages and Tobacco	M/Low
17t18	Textiles and Textile Products	M/Low
19	Leather, Leather and Footwear	M/Low
20	Wood and Products of Wood and Cork	M/Low
21t22	Pulp, Paper, Paper , Printing and Publishing	M/Med
23	Coke, Refined Petroleum and Nuclear Fuel	M/Med
24	Chemicals and Chemical Products	M/High
25	Rubber and Plastics	M/Med
26	Other Non-Metallic Mineral	M/Low
27t28	Basic Metals and Fabricated Metal	M/Low
29	Machinery, Nec	M/High
30t33	Electrical and Optical Equipment	M/High
34t35	Transport Equipment	M/High
36t37	Manufacturing, Nec; Recycling	M/Med
E	Electricity, Gas and Water Supply	S/Med
F	Construction	S/Low
50	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	S/Low
51	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	S/Med
52	Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	S/Med
H	Hotels and Restaurants	S/Low
60	Inland Transport	S/Med
61	Water Transport	S/Med
62	Air Transport	S/High
63	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	S/Med
64	Post and Telecommunications	S/Med
J	Financial Intermediation	S/High
70	Real Estate Activities	S/Med
71t74	Renting of M&Eq and Other Business Activities	S/High
L	Public Admin and Defence; Compulsory Social Security	S/High
M	Education	S/High
N	Health and Social Work	S/High
O	Other Community, Social and Personal Services	S/High
P	Private Households with Employed Persons	S/High

Notes: M/Low – Low-tech manufacturing; M/Med – Medium-tech manufacturing; M/High – High-tech manufacturing; S/Low – Low-tech services; S/Med – Medium-tech services; S/High – High-tech services

Table A2: Summary Statistics by Country

Country	Variance of Wage Growth	Variance of Employment Growth	Narrow Inshoring	Narrow Offshowing	Broad Inshoring	Broad Offshoring
Australia	0.0121	0.0097	0.0894	0.1090	0.1546	0.1476
Austria	0.0003	0.0008	0.1984	0.1728	0.3402	0.2903
Belgium	0.0008	0.0007	0.3313	0.4661	0.8729	0.6125
Bulgaria	0.3600	0.0045	0.2397	0.1849	0.4784	0.5193
Brazil	0.0087	0.0034	0.0476	0.0498	0.1154	0.0846
Canada	0.0037	0.0034	0.2370	0.2534	0.5728	0.2377
Cyprus	0.0180	0.0094	0.2001	0.3177	0.4057	0.3876
Czech Republic	0.0113	0.0025	0.2308	0.3646	0.5493	0.4408
Germany	0.0007	0.0011	0.1164	0.1345	0.2138	0.1758
Denmark	0.0008	0.0033	0.1469	0.2209	0.3722	0.3191
Spain	0.0010	0.0042	0.1031	0.1480	0.1858	0.2160
Estonia	0.0610	0.0456	0.2972	0.4550	0.9893	0.4959
Finland	0.0008	0.0024	0.1675	0.1663	0.3683	0.2297
France	0.0051	0.0007	0.1648	0.1800	0.2981	0.2240
United Kingdom	0.0012	0.0023	0.1140	0.1610	0.2345	0.1917
Greece	0.0077	0.0073	0.0694	0.1823	0.1551	0.2030
Hungary	0.0138	0.0098	0.2567	0.2695	0.4575	0.4684
Indonesia	0.0451	0.0082	0.0869	0.1801	0.2008	0.1311
India	0.0160	0.0024	0.0421	0.0646	0.0974	0.1716
Ireland	0.0054	0.0054	0.2208	0.3639	0.5418	0.6088
Italy	0.0008	0.0009	0.1055	0.1347	0.2208	0.1945
Japan	0.0031	0.0038	0.0420	0.0634	0.0659	0.0668
Korea	0.0105	0.0086	0.1258	0.1757	0.1712	0.2407
Lithuania	0.0904	0.0563	0.3056	0.1726	0.6685	0.5179
Luxembourg	0.0078	0.0110	0.5131	0.3734	1.1427	0.6241
Latvia	0.0577	0.0175	0.4098	0.1810	3.1744	0.3536
Mexico	0.0082	0.0039	0.1765	0.2438	0.3655	0.2695
Malta	0.0341	0.0614	0.2073	0.7460	0.4489	0.3496
Netherlands	0.0010	0.0010	0.2930	0.2766	0.5613	0.5158
Poland	0.0220	0.0111	0.1048	0.1137	0.2388	0.1839
Portugal	0.0011	0.0013	0.1884	0.3307	0.3554	0.3285
Romania	0.1162	0.0431	0.1440	0.1431	0.2039	0.1954
Slovakia	0.0052	0.0050	0.3143	0.3063	0.6338	0.3657
Slovenia	0.0018	0.0022	0.2409	0.3705	0.4442	0.3933
Sweden	0.0010	0.0020	0.2035	0.1737	0.4051	0.3066
Turkey	0.0683	0.0100	0.0287	0.0765	0.0655	0.0946
Taiwan	0.0103	0.0014	0.2344	0.3274	0.4076	0.3427
USA	0.0039	0.0023	0.0577	0.1008	0.1265	0.1176

Notes: This table reports the mean values of the volatility of value added per worker and employment growth by country, along with mean values of the various offshoring and inshoring measures.

Table A3: Summary Statistics by Sector

Sector	Variance of Wage Growth	Variance of Employment Growth	Narrow Inshoring	Narrow Offshowing	Broad Inshoring	Broad Offshoring
Food, Beverages and Tobacco	0.0186	0.0023	0.0837	0.1014	0.1288	0.3169
Textiles and Textile Products	0.0179	0.0053	0.2478	0.3428	0.1702	0.2167
Leather, Leather and Footwear	0.0417	0.0198	0.2374	0.2553	0.2561	0.3327
Wood and Products of Wood and Cork	0.0221	0.0073	0.1817	0.1523	0.5839	0.2519
Pulp, Paper, Paper , Printing and Publishing	0.0201	0.0050	0.1483	0.2486	0.2498	0.1823
Coke, Chemicals and Chemical Products	0.0248	0.0093	0.2825	0.3638	0.6842	0.2491
Rubbers and Plastics	0.0277	0.0115	0.0628	0.1018	0.5743	0.5656
Other Non-Metallic Minerals	0.0234	0.0127	0.0539	0.0683	0.3648	0.2750
Basic Metals and Other Fabricated Metal	0.0205	0.0056	0.4663	0.4632	0.6208	0.2465
Machinery, Nec	0.0226	0.0066	0.1170	0.1992	0.3509	0.4185
Electrical and Optical Equipment	0.0234	0.0063	0.3520	0.6098	0.5360	0.3101
Transport Equipment;	0.0325	0.0194	0.4028	0.3919	0.3247	0.4556
Manufacturing, Nec; Recycling	0.0358	0.0177	0.0408	0.0325	0.3012	0.4070
Agriculture, Hunting, Forestry and Fishing	0.0320	0.0065	0.0201	0.0367	0.1267	0.1409
Mining and Quarrying	0.0391	0.0111	0.0432	0.0406	1.4520	0.1448

Notes: This table reports the mean values of the volatility of value added per worker and employment growth by industry, along with mean values of the various offshoring and inshoring measures.

Table 1(A): Volatility and Narrow Inshoring and Offshoring

	Employment Volatility			Wage Volatility		
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln IN^N$	0.0753*		0.0787**	-0.0406		-0.0401
	(0.0393)		(0.0390)	(0.0450)		(0.0451)
$\ln OFF^N$		-0.0789*	-0.0824*		-0.0215	-0.0207
		(0.0475)	(0.0464)		(0.0508)	(0.0504)
$\ln EMP$	-0.318***	-0.316***	-0.336***			
	(0.0501)	(0.0487)	(0.0496)			
$\ln WAGE$				0.268***	0.287***	0.270***
				(0.0878)	(0.0843)	(0.0881)
Observations	568	568	568	569	569	569
R-squared	0.764	0.764	0.766	0.881	0.881	0.881
F-Statistic	37.95***	38.23***	37.93***	133.1***	132.1***	130.0***

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, All regressions include unreported sector and country fixed effects

Table 1(B): Volatility and Narrow Inshoring and Offshoring

	Employment Volatility			Wage Volatility		
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln IN^N$	0.121**		0.114**	-0.123***		-0.133***
	(0.0489)		(0.0489)	(0.0447)		(0.0459)
$\ln OFF^N$		-0.0752	-0.0637		-0.0954**	-0.108**
		(0.0479)	(0.0469)		(0.0481)	(0.0477)
$\ln EMP$	-0.382***	-0.323***	-0.382***			
	(0.0657)	(0.0556)	(0.0646)			
$\ln WAGE$				0.311***	0.370***	0.333***
				(0.0858)	(0.0815)	(0.0846)
$\ln TRADE$	-0.154*	-0.0213	-0.120	0.364***	0.347***	0.420***
	(0.0865)	(0.0700)	(0.0869)	(0.0708)	(0.0667)	(0.0737)
Observations	568	568	568	569	569	569
R-squared	0.766	0.764	0.767	0.889	0.888	0.891
F-Statistic	37.35***	37.42***	37.23***	138.7***	134.3***	134.4***

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, All regressions include unreported sector and country fixed effects

Table 2(A): Volatility and Broad Inshoring and Offshoring

	Employment Volatility			Wage Volatility		
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln IN^B$	0.0452		0.0835	-0.0471		-0.0587
	(0.0476)		(0.0507)	(0.0547)		(0.0577)
$\ln OFF^B$		-0.171*	-0.210**		0.0434	0.0685
		(0.0898)	(0.0953)		(0.0728)	(0.0764)
$\ln EMP$	-0.307***	-0.311***	-0.326***			
	(0.0498)	(0.0486)	(0.0494)			
$\ln WAGE$				0.267***	0.288***	0.268***
				(0.0883)	(0.0842)	(0.0881)
Observations	568	568	568	569	569	569
R-squared	0.763	0.765	0.767	0.881	0.881	0.881
F-Statistic	37.70***	37.35***	36.93***	132.0***	132.6***	129.4***

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, All regressions include unreported sector and country fixed effects

Table 2(B): Volatility and Broad Inshoring and Offshoring

	Employment Volatility			Wage Volatility		
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln IN^B$	0.0826		0.107*	-0.147***		-0.143***
	(0.0599)		(0.0601)	(0.0532)		(0.0549)
$\ln OFF^B$		-0.167*	-0.196**		-0.0684	-0.0269
		(0.0959)	(0.0957)		(0.0649)	(0.0690)
$\ln EMP$	-0.352***	-0.315***	-0.356***			
	(0.0651)	(0.0554)	(0.0629)			
$\ln WAGE$				0.310***	0.348***	0.311***
				(0.0860)	(0.0826)	(0.0862)
$\ln TRADE$	-0.113	-0.0105	-0.0790	0.370***	0.319***	0.375***
	(0.0889)	(0.0754)	(0.0889)	(0.0713)	(0.0697)	(0.0731)
Observations	568	568	568	569	569	569
R-squared	0.764	0.765	0.767	0.890	0.887	0.890
F-Statistic	37.11***	36.65***	36.56***	136.6***	135.9***	133.9***

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, All regressions include unreported sector and country fixed effects

Table 3(A): Volatility and Narrow Inshoring and Offshoring – Low Skilled (LS)

	(1)	(2)	(3)	(4)	(5)	(6)
ln IN^N	0.0438		0.0468	0.0805		0.0721
	(0.0402)		(0.0392)	(0.0505)		(0.0519)
ln OFF^N		-0.0850*	-0.0867*		-0.0801	-0.0729
		(0.0462)	(0.0455)		(0.0495)	(0.0499)
ln $EMP\ (LS)$	-0.341***	-0.347***	-0.357***	-0.388***	-0.355***	-0.388***
	(0.0484)	(0.0484)	(0.0487)	(0.0649)	(0.0553)	(0.0636)
ln $TRADE$				-0.125	-0.0292	-0.0876
				(0.0866)	(0.0740)	(0.0956)
Observations	569	569	569	569	569	569
R-squared	0.763	0.765	0.766	0.765	0.765	0.767
F-Statistic	46.22***	46.05***	45.47***	45.34***	45.18***	44.59***

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, All regressions include unreported sector and country fixed effects

Table 3(B): Volatility and Narrow Inshoring and Offshoring – Low Skilled (LS)

	(1)	(2)	(3)	(4)	(5)	(6)
ln IN^B	0.00465		0.0346	0.0329		0.0524
	(0.0467)		(0.0507)	(0.0638)		(0.0640)
ln OFF^B		-0.148*	-0.165*		-0.139	-0.154*
		(0.0797)	(0.0865)		(0.0878)	(0.0884)
ln $EMP\ (LS)$	-0.332***	-0.340***	-0.347***	-0.363***	-0.348***	-0.367***
	(0.0480)	(0.0471)	(0.0477)	(0.0654)	(0.0553)	(0.0634)
ln $TRADE$				-0.0851	-0.0277	-0.0594
				(0.0930)	(0.0752)	(0.0943)
Observations	569	569	569	569	569	569
R-squared	0.763	0.765	0.765	0.763	0.765	0.766
F-Statistic	45.86***	44.99***	44.45***	45.20***	44.37***	44.06***

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, All regressions include unreported sector and country fixed effects

Table 4(A): Volatility and Narrow Inshoring and Offshoring – Medium Skilled (MS)

	(1)	(2)	(3)	(4)	(5)	(6)
$\ln IN^N$	0.0305		0.0331	0.0798*		0.0735
	(0.0368)		(0.0368)	(0.0450)		(0.0461)
$\ln OFF^N$		-0.0763*	-0.0775*		-0.0620	-0.0546
		(0.0433)	(0.0432)		(0.0458)	(0.0453)
$\ln EMP\ (MS)$	-0.306***	-0.313***	-0.320***	-0.368***	-0.335***	-0.367***
	(0.0500)	(0.0505)	(0.0518)	(0.0582)	(0.0534)	(0.0595)
$\ln TRADE$				-0.168**	-0.0829	-0.141*
Observations	569	569	569	569	569	569
R-squared	0.791	0.792	0.793	0.794	0.793	0.795
F-Statistic	36.11	36.27	35.67	36.57	35.97	35.92

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, All regressions include unreported sector and country fixed effects

Table 4(B): Volatility and Narrow Inshoring and Offshoring – Medium Skilled (MS)

	(1)	(2)	(3)	(4)	(5)	(6)
$\ln IN^B$	0.0192		0.0306	0.0688		0.0728
	(0.0419)		(0.0440)	(0.0506)		(0.0515)
$\ln OFF^B$		-0.0505	-0.0646		-0.0148	-0.0340
		(0.0665)	(0.0698)		(0.0681)	(0.0680)
$\ln EMP\ (MS)$	-0.302***	-0.301***	-0.306***	-0.355***	-0.331***	-0.355***
	(0.0494)	(0.0490)	(0.0496)	(0.0565)	(0.0526)	(0.0567)
$\ln TRADE$				-0.153**	-0.105*	-0.147**
				(0.0705)	(0.0636)	(0.0722)
Observations	569	569	569	569	569	569
R-squared	0.790	0.791	0.791	0.793	0.792	0.793
F-Statistic	35.94	35.88	35.19	36.13	35.69	35.37

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, All regressions include unreported sector and country fixed effects

Table 5(A): Volatility and Narrow Inshoring and Offshoring – High Skilled (HS)

	(1)	(2)	(3)	(4)	(5)	(6)
$\ln IN^N$	0.0111		0.0116	0.0507		0.0507
	(0.0365)		(0.0365)	(0.0447)		(0.0457)
$\ln OFF^N$		-0.0225	-0.0228		-0.00494	0.000554
		(0.0480)	(0.0480)		(0.0517)	(0.0519)
$\ln EMP\ (HS)$	-0.285***	-0.287***	-0.289***	-0.335***	-0.316***	-0.335***
	(0.0417)	(0.0439)	(0.0437)	(0.0485)	(0.0457)	(0.0485)
$\ln TRADE$				-0.142*	-0.102	-0.142*
				(0.0765)	(0.0691)	(0.0847)
Observations	569	569	569	569	569	569
R-squared	0.790	0.790	0.790	0.792	0.791	0.792
F-Statistic	36.92	36.91	36.18	36.73	36.81	36.06

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, All regressions include unreported sector and country fixed effects

Table 5(B): Volatility and Narrow Inshoring and Offshoring – High Skilled (HS)

	(1)	(2)	(3)	(4)	(5)	(6)
$\ln IN^B$	0.000345		0.00107	0.0404		0.0378
	(0.0434)		(0.0463)	(0.0530)		(0.0541)
$\ln OFF^B$		-0.00362	-0.00413		0.0313	0.0203
		(0.0653)	(0.0697)		(0.0672)	(0.0680)
$\ln EMP\ (HS)$	-0.284***	-0.284***	-0.284***	-0.327***	-0.316***	-0.326***
	(0.0416)	(0.0425)	(0.0420)	(0.0470)	(0.0454)	(0.0469)
$\ln TRADE$				-0.130*	-0.112*	-0.134*
				(0.0767)	(0.0675)	(0.0783)
Observations	569	569	569	569	569	569
R-squared	0.790	0.790	0.790	0.792	0.791	0.792
F-Statistic	36.93	36.86	36.18	36.61	36.82	35.95

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, All regressions include unreported sector and country fixed effects

Table 6: Employment Volatility and Narrow Offshoring and Inshoring – Regional Differences

	(1)	(2)	(3)	(4)	(5)	(6)
$\ln IN^N\ (Other)$	0.0526		0.120	0.109		0.152*
	(0.0676)		(0.0770)	(0.0730)		(0.0809)
$\ln IN^N\ (EU15)$	0.0572		-0.0454	0.109*		-0.00404
	(0.0566)		(0.0780)	(0.0620)		(0.0844)
$\ln IN^N\ (EU12)$	0.0771		0.0676	0.121**		0.0953*
	(0.0479)		(0.0524)	(0.0526)		(0.0567)
$\ln IN^N\ (Asia)$	0.106*		0.124*	0.137**		0.147**
	(0.0640)		(0.0684)	(0.0656)		(0.0706)
$\ln OFF^N\ (Other)$		-0.131**	-0.159**		-0.127**	-0.139**
		(0.0582)	(0.0677)		(0.0597)	(0.0694)
$\ln OFF^N\ (EU15)$		-0.0262	0.0521		-0.0222	0.0571
		(0.0542)	(0.0736)		(0.0554)	(0.0736)
$\ln OFF^N\ (EU12)$		-0.0643	-0.0751		-0.0594	-0.0545
		(0.0554)	(0.0599)		(0.0572)	(0.0620)
$\ln OFF^N\ (Asia)$		-0.102	-0.130*		-0.100	-0.118*
		(0.0635)	(0.0678)		(0.0638)	(0.0684)
$\ln EMP$	-0.319***	-0.331***	-0.348***	-0.380***	-0.338***	-0.385***
	(0.0491)	(0.0483)	(0.0501)	(0.0577)	(0.0526)	(0.0582)
$\ln TRADE$				-0.148**	-0.0229	-0.0995
				(0.0742)	(0.0666)	(0.0779)
Observations	568	568	568	568	568	568
R-squared	0.764	0.765	0.769	0.766	0.765	0.770
F-Statistic	29.58***	29.77***	28.09***	29.31***	29.20***	27.69***

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, All regressions include unreported sector and country fixed effects

Table 7: Employment Volatility and Broad Offshoring and Inshoring – Regional Differences

	(1)	(2)	(3)	(4)	(5)	(6)
$\ln IN^B\ (Other)$	0.0639		0.150	0.110		0.175*
	(0.0894)		(0.0917)	(0.0944)		(0.0958)
$\ln IN^B\ (EU15)$	0.0145		0.0438	0.0528		0.0647
	(0.0816)		(0.0823)	(0.0855)		(0.0855)
$\ln IN^B\ (EU12)$	0.0139		0.0280	0.0499		0.0486
	(0.0581)		(0.0618)	(0.0628)		(0.0659)
$\ln IN^B\ (Asia)$	0.126		0.148*	0.153*		0.164*
	(0.0854)		(0.0862)	(0.0872)		(0.0879)
$\ln OFF^B\ (Other)$		-0.359***	-0.411***		-0.357***	-0.398***
		(0.116)	(0.120)		(0.118)	(0.121)
$\ln OFF^B\ (EU15)$		-0.200*	-0.226**		-0.199*	-0.207*
		(0.108)	(0.110)		(0.112)	(0.112)
$\ln OFF^B\ (EU12)$		-0.0525	-0.0678		-0.0516	-0.0619
		(0.0931)	(0.100)		(0.0948)	(0.100)
$\ln OFF^B\ (Asia)$		-0.181	-0.242		-0.180	-0.232
		(0.159)	(0.161)		(0.160)	(0.162)
$\ln EMP$	-0.314***	-0.325***	-0.347***	-0.357***	-0.326***	-0.373***
	(0.0487)	(0.0474)	(0.0492)	(0.0565)	(0.0522)	(0.0565)
$\ln TRADE$				-0.109	-0.00346	-0.0671
				(0.0733)	(0.0664)	(0.0742)
Observations	568	568	568	568	568	568
R-squared	0.763	0.767	0.770	0.764	0.767	0.770
F-Statistic	29.45	30.10	28.25	29.04	29.51	27.79

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, All regressions include unreported sector and country fixed effects