Globalization of Inflation and Input-Output Linkages

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Abstract: Inflation is highly synchronized across countries. This paper investigates one possible source of inflation synchronization: trade in intermediate inputs. A decomposition of inflation volatility into domestic, common international, and spillover shocks yields that the latter accounts for 20-30% of domestic inflation fluctuations. Furthermore, using sectoral data on trade in intermediate inputs (the World Input-Ouput Database) in combination with sectoral PPI inflation data, I find that cross-border sector pairs that use each other more as intermediate inputs exhibit a higher inflation correlation. This empirical finding suggests that cross-border price spillovers occur partly along the global supply chain.

Key words: Inflation Synchronization; Cross-Border Price Spillovers; Input-Output Linkages; Globalization.

JEL Codes: E31; F15; F62.

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1 Introduction

Differences in inflation rates around the globe have been decreasing substantially over the last decades and inflation rates across countries are highly correlated. Several studies talk about the "globalization of inflation," showing that global factors are able to explain a large share of domestic inflation fluctuations. There are several complementary explanations for the comovement of inflation. The main question is whether the sources of inflation comovement are common shocks or whether shocks are transmitted from one country to the other. On the one hand, commodity prices, business cycle synchronization, commonalities in fiscal and monetary policy, and similar industrial structures represent possible sources of common shocks. On the other hand, international trade increased considerably over the last decades serving potentially as a transmission channel of shocks across countries. International trade can affect domestic inflation via a direct channel coming from imported final goods prices and imported intermediate goods prices, and an indirect channel coming from increased international competition and its effect on domestic price and wage setting decisions. As Bernanke (2007) puts it, "one direct effect of globalization on Federal Reserve operations has been to increase the time and attention that policymakers and staff must devote to following and understanding developments in other economies, in the world trading system, and in world capital markets."

This paper investigates whether input-output linkages in production networks, i.e. the import of intermediate inputs, matter for inflation comovement across countries. The focus on trade in intermediate goods is motivated by the fact that trade has become increasingly more vertical with a higher share devoted to intermediate inputs instead of final goods. Furthermore, the effect of trade in intermediate inputs on inflation may be different than the effect of trade in final goods.

The paper is divided into three parts. In a first introductory step, I build on the literature on international business cycles to determine the share of domestic inflation volatility that is explained by domestic, common international, and cross-border spillover shocks. I find that the share of inflation variance that can be explained by cross-border spillover shocks is sizeable, ranging from 20% to 32% in the countries in my sample. In a second step, I use a novel, cross-country, sector-level panel dataset on the trade in intermediate inputs, the World Input-Output Database (WIOD; Timmer et al., 2015), in combination with sectoral inflation data to study the relationship between trade in intermediate inputs and inflation comovement. I find that cross-border sector pairs which use more intermediate inputs from each other exhibit a higher inflation comovement. A one percentage point increase in the imported input intensity (imported inputs/gross output) that cross-border sector pairs use from each other increases their correlation by one percentage point. On average, a one percentage point increase in the imported input intensity in all sectors increases the aggregate PPI inflation correlation between two countries by 3 percentage points, which amounts to a 6% increase over the average aggregate inflation correlation in the sample. In contrast, overall bilateral trade intensity (trade in intermediate and final goods) seems to diminish inflation correlation. Third, I analyze to what extent sectoral inflation reacts to changes in production costs and exchange rates in cross-border sectors supplying intermediate inputs. I show that there are cost and exchange rate pass-throughs along the global supply chain and that these pass-throughs are higher in sectors that rely more on intermediate inputs.

There is a recent yet growing literature which seeks to understand inflation by looking at global factors. This literature builds on previous studies on international business cycle synchronization. Wang and Wen (2007) document that inflation synchronization across countries is even higher than GDP growth synchronization. Mumtaz and Surico (2008) decompose inflation fluctuations into domestic components and common international components. Borio and Filardo (2007) show that the inclusion of a global output gap in a New Keynesian Phillips curve considerably increases its explanatory power and that the importance of the global output gap has increased over time. By the same token, Ciccarelli and Mojon (2010) as well as Ferroni and Mojon (2014) find that one common factor or simply global inflation defined as average cross-country inflation can explain a large share of domestic inflation volatilities. Going one step further and using CPI data at the product level, Monacelli and Sala (2009) report that inflation in sectors which are more open to trade shows a higher dependence on international common factors. Auer and Sauré (2013) document using a sample of OECD countries that bilateral sectoral cross-border price spillover is higher if two sectors trade more with each other. Few papers focus specifically on the imported input channel. Goldberg and Campa (2010) highlight that imported intermediate inputs are the dominant channel through which changes in import prices pass to CPI inflation and that the pass-through depends positively on the elasticity of substitution between inputs. Using a firm-level dataset of French firms, Martin (2011) shows that producer prices are sensitive to imported input prices. Auer and Mehrotra (2014) show using the WIOD for a sample of Asia-Pacific countries that sectoral domestic producer prices depend on the import prices of intermediate inputs.

My analysis also builds on the literature on business cycle comovement. In particular, it applies to inflation the Factor-Structural VAR methodology (Clark and Shin, 2000; Stock and Watson, 2005; Artis et al., 2011) developed to decompose GDP growth into domestic, common international, and cross-border spillover shocks. Moreover, I make use of the connectedness table concept from Diebold and Yilmaz (2015) to distribute the spillover effects across source countries. Last, I use the novel World-Input Output Database to implement to inflation the Di Giovanni and Levchenko (2010)'s analysis, which shows that cross-border sector pairs that use each other more as intermediate inputs exhibit higher business cycle comovement.

My paper differs from these papers in a number of ways. First, unlike Mumtaz and Surico (2008), I do not only decompose inflation volatility into domestic and international shocks but relying on Clark and Shin (2000)'s identification strategy I decompose it into domestic, common international, and cross-border spillover shocks. Second, to the best of my knowledge, this is the first paper that uses the full wealth of the WIOD to study cross-border spillovers. Di Giovanni and Levchenko (2010)'s paper on GDP synchronization was written before the WIOD release and they assume that the distribution of input-output linkages across sectors in the U.S. also holds for international trade across countries. Auer and Mehrotra (2014)'s analysis using the WIOD is restricted to Asia-Pacific countries and they focus on the question of whether domestic producer prices depend on import prices. Their analysis of inflation comovement is done with aggregate data. Instead, I use PPI inflation correlations between all cross-border sector pairs from the WIOD which includes 40 countries and 14 manufacturing sectors to show that inflation correlation is higher when cross-border sector pairs use more intermediate inputs from each other. As noted in Di Giovanni and Levchenko (2010)'s analysis, the granularity of the data with its four dimensions (import country x export country x import sector x export sector) is essential for identifying the effect of imported intermediate inputs, as it allows to control for common unobservable shocks between cross-border sectors with the inclusion of country-pair and sector-pair fixed effects. Finally, in the last section of this paper I conduct a production cost and exchange rate pass-through analysis. There are two novel components in the way I calculate foreign producer prices and effective exchange rates. First, foreign weights are based on trade in intermediate inputs instead of overall trade. Second, foreign producer prices are built at the sectoral level taking into account producer prices in every foreign sector that supplies intermediate inputs.

The remainder of the paper is organized as follows. Section 2 documents some facts about the globalization of inflation. Section 3 estimates the share of domestic inflation fluctuations which are due to domestic shocks, common international shocks, and cross-border spillover shocks. Section 4 describes the data on cross-border sectoral trade in intermediate inputs and on sectoral inflation. Section 5 examines whether linkages along the global supply chain can explain cross-border sector pair inflation correlations. Section 6 analyzes in a panel to what extent domestic sectoral inflation reacts to changes in production costs and exchange rates along the global supply chain. Finally, Section 7 concludes.

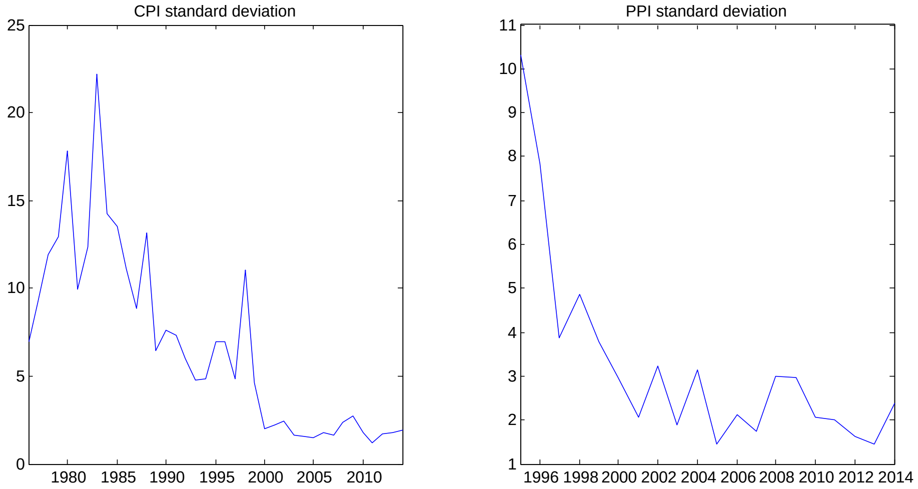
2 The globalization of inflation

Inflation is highly synchronized across countries. Table A.5 in the appendix shows the correlation of monthly year-on-year (yoy) PPI inflation rates between 2002:M01 and 2014:M12 for 40 countries, which make up 85% of world GDP. Average aggregate inflation correlation amounts to 52% and rises to 64% if emerging markets and Eastern European countries are excluded from the sample. The highest correlation is 97% (between France and Italy) and the lowest absolute correlation is 0% (between Turkey and Luxembourg). These high correlations are not the artefact of a common trend, the average correlation of the HP-filtered data is even higher at 56%. Using month-on-month (mom) inflation rates, which is likely to magnify the importance of idiosyncratic high frequency movements (see Monacelli and Sala, 2009), the average correlation decreases to 33%. The numbers are similar for CPI inflation rates. This paper focuses on PPI inflation because I am mainly interested in cross-border price spillovers along the global supply chain and sector definitions in the PPI database coincide with sector definitions in the WIOD database. Reliable aggregate producer prices are available for most developed countries from 1995 onwards, but in order to avoid structural breaks due to the creation of the EMU in 1998 and China's accession to the WTO in 2002, the estimation period starts in 2002. Moreover, the analysis in the next sections is going to rely on *sectoral* PPI inflation for 40 countries, for which data are available mainly from 2002 onwards.

Figure 1 shows the cross-sectional standard deviation of annual inflation rates for OECD countries over time, from 1976 to 2014 in the case of CPI inflation and from 1995 to 2014 in the case of PPI inflation. Inflation rates have become more similar across countries over time. The cross-sectional standard deviation decreases over time. In 1976 the standard deviation of CPI inflation rates across OECD countries was 7 percentage points and it decreases to 2 percentage points in 2014.

There are many potential reasons why inflation rates are highly synchronized. Inflation rates are sensitive to oil and other commodity prices, countries may be subject to similar monetary and fiscal policy, or may experience similar shocks to fundamentals. In the next section I investigate whether cross-border spillovers are important for domestic aggregate PPI inflation fluctuations. After that, I use a granular cross-country sectoral dataset to analyze whether some of these cross-border spillovers are transmitted along the global supply chain, i.e. from firms producing intermediate inputs in one country to firms demanding these intermediate inputs in another country.

Figure 1: Cross-sectional inflation standard deviation over time



Source: OECD. Countries included in the calculation of the cross-sectional CPI inflation standard deviation: AUS, AUT, BEL, CAN, COL, CHE, CHL, CZE, DEU, DNK, ESP, FIN, FRA, GRB, GRC, IND, IDN, IRL, ISR, ITA, JPN, KOR, LUX, MEX, NLD, NLZ, NOR, PRT, SVK, SWE, TUR, USA and ZAF. Countries included in the calculation of the cross-sectional PPI inflation standard deviation: BEL, CZE, DEU, DNK, ESP, FIN, FRA, GRC, IRL, ITA, JPN, KOR, LUX, MEX, NLD, NOR, PRT, SVK, SWE, TUR, and ZAF.

3 The importance of cross-border spillovers to inflation

In this section I determine the importance of cross-border price spillovers to inflation using a Factor-Structural VAR (FSVAR). The FSVAR was used in several previous studies (Clark and Shin, 2000; Stock and Watson, 2005; Artis et al., 2011) to decompose GDP volatility into domestic, common international, and cross-border spillover shocks. Shocks are identified by imposing a factor-structure to the error terms such that there are international shocks represented by factors which affect all countries in the same period with different loadings and domestic shocks which affect only the domestic country in the first period. In this framework spillovers can only happen with a lag and the fraction of the volatility explained by spillovers is one minus the fraction of the volatility explained by domestic and common international shocks. The FSVAR model is given by the following equations:

$$\begin{pmatrix} \pi_{1,t} \\ \vdots \\ \pi_{n,t} \end{pmatrix} = \sum_{p=1}^{L} \begin{pmatrix} a_{11}^{p} & \cdots & a_{n1}^{p} \\ \vdots & \ddots & \vdots \\ a_{n1}^{p} & \cdots & a_{nn}^{p} \end{pmatrix} \begin{pmatrix} \pi_{1,t-p} \\ \vdots \\ \pi_{n,t-p} \end{pmatrix} + \begin{pmatrix} \nu_{1t} \\ \vdots \\ \nu_{nt} \end{pmatrix} \tag{1}$$

$$\begin{pmatrix} \nu_{1,t} \\ \vdots \\ \nu_{n,t} \end{pmatrix} = G\zeta_t + \begin{pmatrix} \eta_{1,t} \\ \vdots \\ \eta_{n,t} \end{pmatrix} \tag{2}$$

where π_{it} represents mom producer prices inflation in country i in month t; ζ_t are common international factors affecting inflation simultaneously in all countries; G is a matrix of factor loadings; and η_{it} are country-specific shocks. The covariance matrices $E(\zeta_t\prime\zeta_t)$ and $E(\eta_t\prime\eta_t)$ are diagonal. As in Stock and Watson (2005), I allow the number of lags of domestic inflation to differ from the number of lags of foreign inflation rates. The AIC and BIC criteria point to a VAR with two domestic lags and one foreign lag, meaning that domestic inflation depends on two own lagged values and on one lag of all foreign inflation rates. I consider a model with one common international shock. The FSVAR is estimated by Gaussian maximum likelihood. By definition, the model may misidentify as international shocks country-specific shocks which spillover to other countries within a month. Likewise, international shocks which first affect one country and with a lag the others may be misidentified as spillover shocks instead of international shocks. Important to bear in mind is also the fact that the effect of spillover and international shocks may be sensitive to the countries included in the sample.

Table 1 reports the results of the FSVAR estimation with a sample including major exporters of manufacturing intermediate inputs (CN, DE, FR, IT, JP, US). The estimation period is from 2002:M01 to 2014:M12. By definition,

Table 1: Inflation variance decomposition

Estimation period 2002:M01-2014:M12

	h (months)	Int shocks	Own shock	Spillover		h (months)	Int shocks	Own shock	Spillover
CN	1	0.06	0.95	0.00	IT	1	0.29	0.71	0.00
CN	2	0.10	0.85	0.05	IT	2	0.30	0.66	0.03
CN	4	0.15	0.68	0.17	IT	4	0.33	0.55	0.12
CN	8	0.17	0.56	0.27	IT	8	0.33	0.44	0.23
DE	1	0.15	0.85	0.00	JP	1	0.04	0.96	0.00
DE	2	0.21	0.73	0.06	JP	2	0.07	0.89	0.04
DE	4	0.30	0.53	0.17	JP	4	0.11	0.78	0.11
DE	8	0.39	0.29	0.32	JP	8	0.14	0.66	0.20
FR	1	0.13	0.87	0.00	US	1	0.18	0.82	0.00
FR	2	0.16	0.81	0.03	US	2	0.20	0.74	0.06
FR	4	0.19	0.69	0.12	US	4	0.21	0.63	0.15
FR	8	0.21	0.59	0.20	US	8	0.21	0.55	0.23

due to the identification strategy, at the one month horizon spillover shocks account for none of the forecast error variance. At the first-month horizon the largest share of inflation variance is attributed to domestic shocks, but their importance decreases over time, while the importance of both international shocks (common shocks and spillovers) increases over time. At the eight-month horizon both sources of international shocks account for between 34% in Japan and 71% in Germany of the inflation variance. Spillover shocks in particular account for between 20% and 32% of the inflation variance at the eight-month horizon. The results depend to some extent on the sample of countries. Table A.6 in the appendix shows how the results change if Italy, a large trading partner of Germany and France, is replaced in the sample by Korea, a large trading partner of China and Japan. With this change in the sample, spillovers explain a smaller share of the variance in Germany and in France and a larger share in China and in Japan. However, the results show that, irrespectively of the sample, the influence of international factors on domestic inflation is sizeable and that this influence is not only due to common international shocks, such as commodity prices, but to a large extent also due to spillovers across countries, which explain roughly one third of the inflation variance.

When talking about spillovers it is interesting to decompose the spillover shocks coming from each country and to analyze which foreign countries contribute the most to domestic inflation fluctuations. For this, I merge the FSVAR shock identification scheme with the concept of a connectedness table from Diebold and Yilmaz (2015). Diebold and Yilmaz (2015) construct a connectedness table showing how much the country in a column contributes to the forecast error variance of industrial production growth of the country in a row. In their paper the connectedness table is based on generalized impulse response functions. Hence, the variance is decomposed into own shocks and shocks from other countries, there is no identification of international common shocks and the domestic shocks are correlated across countries. My connectedness table (Table 2) is based on the FSVAR methodology at the eight-month horizon instead of a generalized VAR. In the connectedness table I focus on the variance of inflation that is due to domestic and spillover shocks. Table 1 reports the fraction of this variance that is due to shocks originating in a particular country. By construction, the rows sum to one. For example, according to Table 1, own and spillover shocks account for 61% of German inflation variance at the 8 month horizon. So, abstracting from international common shocks, Table 2 shows that own shocks can explain 48% (0.29/0.61) of the German variance at the 8 month horizon. The remaining 52% related to spillover shocks (0.32/0.61) are distributed across the other five countries.

Table 2: Connectedness table

	CN	DE	FR	IT	JP	US	FROM others
CN	0.68	0.08	0.12	0.02	0.00	0.10	0.32
DE	0.24	0.48	0.08	0.16	0.02	0.01	0.52
FR	0.15	0.04	0.75	0.04	0.00	0.02	0.25
IT	0.14	0.08	0.07	0.66	0.02	0.04	0.34
JP	0.01	0.06	0.05	0.02	0.77	0.09	0.23
US	0.06	0.12	0.09	0.02	0.00	0.70	0.30
TO others	0.60	0.39	0.41	0.26	0.05	0.25	
NET TO-FROM	0.28	-0.13	0.16	-0.08	-0.19	-0.04	Index=0.33

Germany has the highest share of inflation variance explained by spillovers from other countries (0.52) among the countries in the sample. This is also in line with Diebold and Yilmaz (2015)'s findings for industrial production, in which Germany received the highest percentage of shocks from foreign countries. On the other hand, China is the country which contributes the most to other countries' inflation forecast error variance (0.60). In my sample Japan is the country which receives the smallest share of shocks from other countries (0.23) and at the same time the country which transmits to the smallest extent shocks to others (0.05). Taking Italy as an example, Table 2 reports that the highest share of Italian inflation variance is explained by inflation shocks from Italy, namely 66%. China contributes to 14% of the Italian inflation forecast variance, followed by Germany with 8%, France with 7%, US with 4% and Japan with 2%. Next, I calculate the Diebold and Yilmaz (2015)'s so-called connectedness index by averaging the last column in Table 2. This connectedness index shows the average share of inflation variance that can be explained by other countries and amounts to 0.33 in my sample.

4 Sectoral data on trade in intermediate inputs and inflation

Having determined that cross-border spillovers do play an important role in inflation dynamics, I analyze whether some of these cross-border price spillovers are transmitted along the global supply chain. For this purpose, I make use of a novel granular cross-border panel dataset at the sectoral level on trade in intermediate inputs in combination with data on sectoral inflation. In this section I present the data.

Data on cross-border input-output linkages come from the novel World Input-Output Database (WIOD; Timmer et al., 2015). The WIOD has several advantages over previously available datasets. First, it is annually from 1995 to 2011, while previous domestic input-output tables for many countries were only available for every five years or so. Second, it comprises in one dataset input-output tables for 40 countries (27 EU countries and other major developed and emerging economies)[2] representing more than 85% of the world GDP. Third and for the purpose of this study most importantly, imported intermediate inputs are broken down by exporting country and exporting sector. Previous to the WIOD, it was possible to know the amount of intermediate inputs that a sector imports but not from which country and from which sector in this country. The WIOD is a matrix with the dimension (40 countries x 35 sectors) x (40 countries x 35 sectors) showing the amount of inputs that a sector in a row exports to all other sectors in all other countries in the columns. In this paper I will focus on the 14 manufacturing sectors because the manufacturing sector has the largest share in trade in intermediate inputs (61%), these goods are tradable, and sectoral manufacturing producer prices are easily available.

The imported input ratio, defined as the ratio of imported intermediate inputs to gross output, increased by 50% between 1995 and 2007 from 6% to 9%. The share attributed to the raw materials sector almost doubled from 0.7% to 1.3%, the share attributed to manufacturing increased from 4% to 6%, and the share of services from 1% to 2%. Intermediate inputs represented around 66% of overall trade in 2007. The share of intermediate inputs in overall trade varies by sector, it stands at 91% in the raw material sector, at 58% in the manufacturing sector and at 81% in the services sector.

Focusing from now on only on manufacturing sectors which import intermediate inputs from other manufacturing sectors, Figure 2 depicts which countries are the most active in the global supply chain. More precisely, the upper graph depicts countries' ratios of imported intermediate inputs to output in the manufacturing sector, while the lower graph reports countries' shares in total exports of manufacturing inputs. Not surprisingly, small countries, such as Malta, Luxembourg and Slovakia, are the countries which have the highest imported input ratio (above 34%), while larger countries, such as Japan and the U.S., have a much lower ratio of imported intermediate inputs to output (below 8%). However, there are also large countries, such

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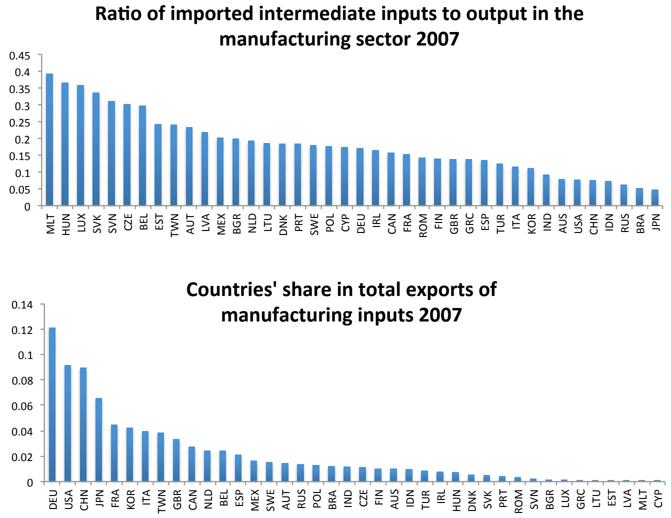
[2] AUS, AUT, BEL, BGR, BRA, CAN, CHN, CYP, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HUN, IDN, IND, IRL, ITA, JPN, KOR, LTU, LUX, LVA, MEX, MLT, NLD, POL, PRT, ROM, RUS, SVK, SVN, SWE, TUR, TWN, and USA.

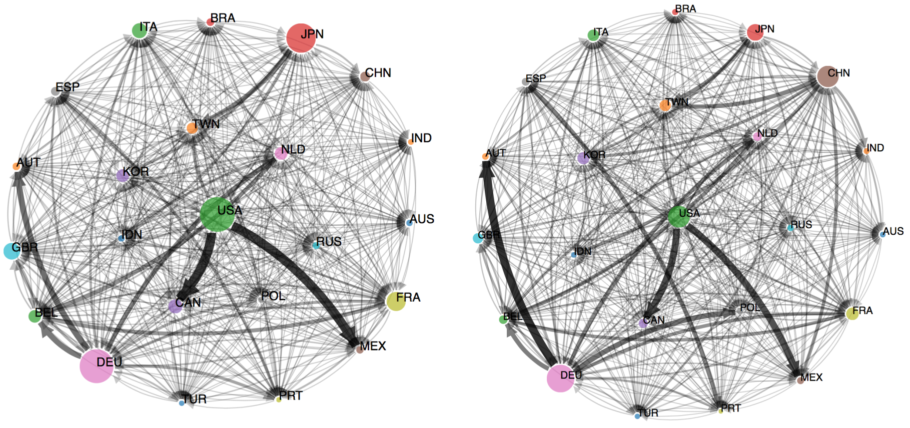
as Mexico and Germany, that are very active in the global supply chain and have an imported input ratio above 17%. Figure 2 also shows that Germany, the U.S., China, Japan, and France are the largest exporters of intermediate inputs.

Figure 2:



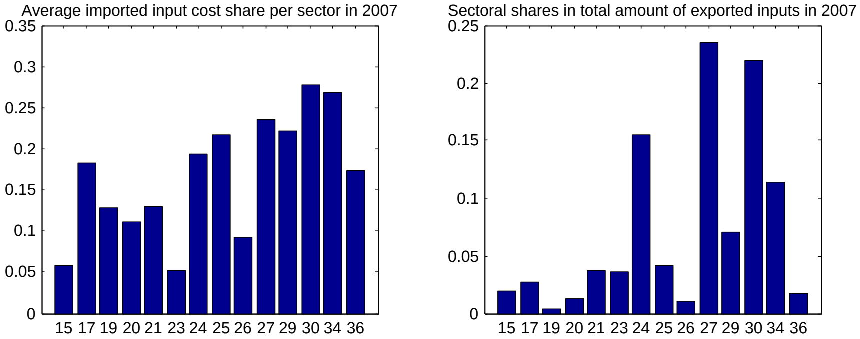
The matrix of input-output linkages reveals also the direction of trade, which can be easily visualized in a network. Figure 3 shows the input-output linkages between countries in 1995 and in 2007. For the sake of clarity, I restrict the network to the largest 23 countries among the 40 countries in the sample. The nodes in the network represents the countries and an arrow from country i to country j means that country i exports intermediate inputs to country j. The location of the nodes is arbitrary, the size of the nodes is proportional to the share of the countries in total exports of manufacturing intermediate inputs, and the arrow thickness is proportional to the ratio of imported intermediate inputs to total manufacturing gross output in the import country. The input-output network for 1995 shows that Germany, Japan and the U.S. were the largest exporters of intermediate inputs in 1995, as their nodes are the largest. It is also clear that the strongest relationships in the global supply chain are regional. As a share of their manufacturing out-puts, Mexico and Canada are the countries which most import intermediate inputs from the U.S. Similarly, Austria, Belgium and the Netherlands are the countries which most import intermediate inputs from Germany and Taiwan from Japan. Although the U.S. also imports intermediate inputs let's say from Mexico, this arrow can be barely seen as the thickness of the arrow is proportional to the value of imports of intermediate inputs divided by total output. The input-output table of 2007 is denser, meaning that more countries are importing intermediate inputs. China has also considerably gained market share in the total exports of manufacturing intermediate inputs and as a logical consequence, other countries have lost market share. This can be observed from China's larger node in 2007. The arrows from Canada and Mexico to the U.S. have become thinner in 2007, mainly because these countries are now also importing intermediate inputs from China. In 2007 Germany also became an important supplier of intermediate inputs to Eastern European countries, which became more integrated in the supply chain, such as Poland.

Figure 3: Input-Output Linkage Network 1995/2007



The utmost purpose of this paper is to show that cross-border sector pairs which trade more intermediate inputs with each other exhibit a higher inflation correlation. The central variables in the analysis are then imported input ratios at the sectoral level and cross-border sectoral inflation correlations. A necessary condition to find a relationship between these two variables is that there is some cross-sectional variation in the share of imported inputs used by different sectors. Figure 4 shows that this is the case for the 14 manufacturing sectors under analysis by depicting the average sectoral imported input ratios across the 40 countries in the sample in 2007. The Food and Beverage sector (15) and the Coke and Refined Petroleum sector (23) are the ones which have the lowest ratio of imported manufacturing inputs to output at around 5%. On the other hand, the Electrical and Optical Equipment sector (30), under which personal computers fall, and the Transport Equipment sector (34) are the sectors which display the highest share of imported intermediate inputs of almost 30%. It may be counterintuitive that the Coke and Refined Petroleum sector presents such a low ratio of imported inputs to output. This is due to the fact that here I consider only *manufacturing* imported intermediate inputs and the sector Coke and Refined petroleum imports mainly from the sector Mining and Quarrying (32% of its output), which is not a manufacturing sector.

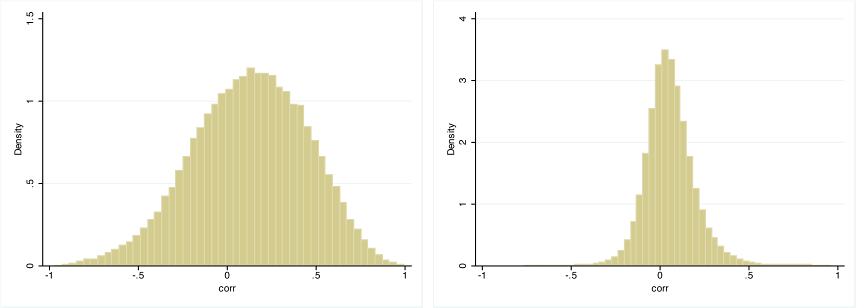
Figure 4: Share of imported intermediate inputs across sectors in 2007



15=Food and beverages, 17=Textiles, 19=Leather and leather products, 20=Wood and wood products, 21=Paper and related paper products, 23=Coke and refined petroleum, 24=Chemicals and chemical products, 25=Rubber and plastics, 26=Other non-metallic minerals, 27=Metals, 29=Machinery nec, 30=Electrical and Optical Equipment, 34=Transport Equipment, 36=Manufacturing nec

Finally, Figure 5 shows the histogram of the correlations between cross-border sector pair inflation rates between 2002:M01 and 2014:M12. The left-hand histogram shows the correlations based on yoy changes, while the right-hand histogram shows the correlations based on mom changes. The mean correlation based on yoy changes is 13% with 25% and 75% quantiles at -9% and 37%, respectively. These correlations are lower than correlations of aggregate inflation rates, which is no surprise, as sector pairs are less exposed to common shocks. The correlations of mom sectoral inflation rates, which emphasize high-frequency idiosyncratic changes, are lower with a mean of 6% and 25% and 75% quantiles of -2% and 13%.

Figure 5: Correlation of cross-border sector pair inflation rates (2002:M01-2014:M12), yoy/mom



5 Inflation correlation and trade in intermediate inputs

The biggest challenge in identifying a relationship between inflation comovement and trade in intermediate inputs is the fact that there are unobservable common shocks affecting inflation rates in different countries and sectors simultaneously. Disaggregated data at the sector level in contrast to aggregate data at the country level can address this concern. The granularity of the WIOD with its four dimension (import country x export country x import sector x export sector) allows to control for common shocks with the inclusion of a rich set of fixed effects. I estimate the following equation borrowing the methodology from Di Giovanni and Levchenko (2010):

$$\rho_{ij}^{ab} = \alpha + \beta(IO_{ij}^{ab} + IO_{ji}^{ba}) + \boldsymbol{\Phi FE} + \epsilon_{ij}^{ab}, \tag{3}$$

where ρ_{ij}^{ab} is the correlation between the monthly yoy PPI inflation rates in sector i in country A and in sector j in country B between 2002:M01 and 2014:M12; IO_{ij}^{ab} stands for imported intermediate input intensity, i.e. the value of intermediate inputs of sector i in country A required to produce 1$ of final output in sector j in country B (average of the years 2002-2011); and $\boldsymbol{FE}$ stands for a set of fixed effects.

The coefficient on IO_{ij}^{ab} and the coefficient on IO_{ji}^{ba} are constrained to be the same, namely β, regardless of the direction of trade because the dependent variable, the correlation between cross-border sectors' inflation rates ρ_{ij}^{ab}, is non-directional and the indices are completely interchangeable. I use three different fixed-effects specifications. First, I control for export country, import country and sector fixed effects; controlling for average country and sector characteristics' influence on inflation comovement between country-sector pairs. Country characteristics can be the capacity to influence global prices, monetary or fiscal policy, exposure to commodity prices, or overall volatility of inflation. Sector fixed effects can control for exposure to commodity prices, overall volatility, reliance on trade, reliance on external finance, R&D intensity, labor intensity, or market power. Second, it is also possible to estimate the model controlling for country-sector fixed effects; controlling for characteristics specific to a sector in a country, such as tariff and non-tariff barriers. Third, I control for country-pair and sector-pair fixed effects. This specification seems to be the best to control for common shocks or common trends which can affect the correlation between inflation rates. Country-pair effects can absorb trade and financial integration between countries, commonalities in exchange rate regime, monetary and fiscal policy, business cycle synchronization, similarities in exposure to global factors, similarities in industrial structure and so on. At the same time, sector-pair effects can capture whether a sector pair is exposed to similar global factors, has the same input structure, among others.

Table 3 presents the results from the estimation of equation (3). The first three columns report the results using different sets of fixed effects. In all specifications there is a positive and highly significant relationship between the amount of intermediate inputs that a cross-border sector pair uses from each other and the correlation of their inflation rates. However, the effects become much smaller if common shocks are taken into account with the inclusion of country-pair and sector-pair fixed effects. A one percentage point increase in the imported input intensity (0.01) increases pairwise correlation by approximately 8 percentage points (0.08) when using country and sector fixed effects (column (1)) or country-sector pair fixed effects (column (2)). However, when using country-pair and sector-pair fixed effects (column (3)), which are more stringent fixed effects, this effect decreases to 0.01. Columns (4)-(10) use the specification with country-pair and sector-pair fixed effects including additional explanatory variables or changing the sample. An essential variable for the imported input intensity to have an influence on inflation correlation is the elasticity of substitution between inputs in production. If the elasticity of substitution between inputs is high, then there may be no relationship between the imported input intensity and inflation comovement, as sectors are able to substitute away from more expensive inputs. I follow Di Giovanni and Levchenko (2010) and use estimated sectoral elasticities of substitution between inputs from Luong (2011). Column (4) adds to the baseline equation an interaction term between imported input intensity and the elasticity of substitution. The latter is calculated by summing up the elasticities of substitutions in the two sectors under consideration. As predicted by theory, the coefficient on this interaction term is negative and significant, meaning that comovement is lower in sectors with higher elasticity of substitution between inputs. The coefficient of the imported input intensity remains positive and significant. The highest share of trade happens at the intra-sectoral level. Several previous studies (e.g., Di Giovanni and Levchenko, 2010; Calderon et al., 2007) show that intra-sector trade is the main responsible for the positive relationship between trade and GDP comovement and that transmission occurs predominantly between advanced economies. Column (5) adds an interaction term between imported input intensity and a dummy indicating whether trade is between the same sector in two different countries. By the same token, Column (6) adds an interaction term between the imported input intensity and a dummy indicating whether both countries trading are developed countries.[3] The results indicate that the effect of trade in intermediate inputs on inflation comovement happens predominantly via intra-sector trade and among developed countries. Both interaction terms are positive and significant, and render the effect of imported input intensity alone insignificant.

Columns (7) and (8) add two different indicators of overall bilateral trade intensity. The numerator of both indicators is the same, namely overall exports (intermediate inputs and final goods) of sector i in country A to country B plus overall exports of sector j in country B to country A. In the first indicator I scale this numerator by gross output in country A and B, and in the second by trade (exports plus imports) in country A and B. The effect of overall trade on cross-border sectoral inflation correlation has the opposite sign of the effect of trade in intermediate inputs. The higher the overall trade intensity, the lower is the inflation correlation. The coefficient of overall trade continues to be negative if I do not control for the imported input intensity. Ng (2010) gets the same result when analyzing GDP comovement between countries, while Di Giovanni and Levchenko (2010) find that overall bilateral trade as well as trade in intermediate inputs increases GDP comovement at the sectoral level. Moreover, my result is in line with the predictions of a two-country DSGE model with three-stage supply chains (Wong and Eng, 2013), which shows that with vertical specialization cross-country correlation in output and PPI inflation is positive, and when considering only trade in final goods these are negative. That trade in intermediate inputs increases inflation correlation via the prices of imported intermediate inputs is intuitive. Less intuitive is why overall bilateral trade intensity decreases inflation comovement. Let's assume a positive supply shock in country A. This would decrease prices and increase output in country A. Since country A is more productive, resources will be shifted from country B to country A, decreasing output in country B. There are several alternatives to model how this could make prices in country B go up. One could think of countercyclical mark-ups, of elasticities of demand which depend positively on the quantity

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[3] The definition of developed countries here excludes Eastern European and emerging market countries.

sold and imply higher markups when less is sold a la Kimball (1995), or of mark-ups which depend negatively on the liquidity of firms a la Gilchrist et al. (2015). Alternatively, one could think of increasing marginal costs due to a lower marginal productivity of labor arising from the lower availability of capital.

Another concern is that a high share of the countries in the WIOD dataset are euro area countries which participate in a monetary and custom union, in which transmission via trade may be stronger. To ensure that the results are not driven by euro area countries, I reestimate the baseline equation without trade within the euro area in column (9). The effect of imported input intensity is still significant and positive, although with a lower magnitude. Finally, many country-sector pairs do not trade any intermediate input with each other, such as textiles in Austria with chemicals in Australia. In column (7) I estimate the equation leaving out country-sector pairs which do not trade intermediate inputs with each other. The coefficient of the imported input intensity loses magnitude, but remains positive and significant.

Table A.7 in the appendix repeats the same analysis using correlations between mom inflation rates instead of monthly yoy inflation rates. As shown in the previous section, mom inflation rates emphasize idiosyncratic high-frequency movements in the inflation rate to the detriment of the relevance of common shocks and thus, correlations based on mom inflation rates are lower. Table A.7 shows that the main results continue to hold if one uses correlation between mom inflation rates instead of yoy inflation rates.

Next, I study the importance of trade in intermediate inputs for *aggregate* PPI inflation comovement. After the estimation of equation (3) it is possible to predict the changes in sector-level inflation comovement related to a given change in imported input intensity, namely $\Delta\rho^{ab}_{ij} = \beta\Delta(IO^{ab}_{ij} + IO^{ba}_{ji})$. Once the predicted changes in sector-level inflation comovement are calculated, it is easy to pin-down the effects on aggregate PPI inflation comovement according to the following equation:

$$\Delta\rho^{ab} = \frac{1}{\sigma^a\sigma^b}\sum_{i=0}^{N}\sum_{j=0}^{N} s^a_i s^b_j \sigma^a_i \sigma^b_j \Delta\rho^{ab}_{ij}, \tag{4}$$

where σ^a stands for the standard deviation of aggregate PPI inflation in country A, s_i^a stands for the share that sector i has in country A's manufacturing output, and σ_i^a stands for the standard deviation of inflation in sector i in country A. The average standard deviation of aggregate manufacturing inflation is $\bar{\sigma}^a = \bar{\sigma}^b = 0.04$, while the average standard deviation of sectoral inflation is $\bar{\sigma}_i^a = \bar{\sigma}_j^b = 0.05$, and finally the average sector share in manufacturing input is $\bar{s}_i^a = \bar{s}_j^b = 0.07$. I assume that every sector pair in two countries increases their imported input intensity $(IO_{ij}^{ab} + IO_{ji}^{ba})$ by 1 percentage point and calculate the effect on aggregate inflation correlation between these two countries. The effect is not the same for every country-pair as their σ^a, σ^b, s_i^a, s_j^b, σ_i^a, and σ_j^b differ. On average, a one percentage point increase in the imported input intensity between all sectors increases aggregate inflation correlation between two countries by 3 percentage points, which amounts to a 6% increase over the average aggregate correlation in my sample.

Table 3: Regression Results

Dependent variable: cross-border sectoral inflation correlation (PPI, yoy, 2002:M01-2014:M12)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9) w/o EMU-pairs	(10) w/o 0
IO	7.41***	8.08***	1.45***	3.99***	-0.21	0.39	1.96***	1.59***	0.97**	0.82**
	(0.54)	(0.54)	(0.38)	(1.62)	(0.79)	(0.51)	(0.39)	(0.39)	(0.45)	(0.38)
IO × elasticity of substitution				-3.51***						
				(2.13)						
IO × $I_{(s_i==s_j)}$					1.93**					
					(0.86)					
IO × $I_{(\text{dev. country-pair})}$						1.97***				
						(0.69)				
$I_{(s_i==s_j)}$					0.38***					
					(0.02)					
$I_{(\text{dev. country-pair})}$						0.07***				
						(0.02)				
$(X_i^{ab} + X_j^{ba})/(Y_a + Y_b)$							-43.74***			
							(5.82)			
$(X_i^{ab} + X_j^{ba})/(X_a + M_a + X_b + M_b)$								-2.52**		
								(1.15)		
Fixed effects										
$c_a + c_b + s_i + s_j$	Yes									
$c_a \times s_i + c_b \times s_j$		Yes								
$c_a \times c_b + s_i \times s_j$			Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# obs	82,798	82,798	82,798	82,798	82,798	82,798	82,798	82,798	72,333	46,920
R^2	0.20	0.34	0.32	0.32	0.32	0.32	0.32	0.32	0.30	0.38

The equation is estimated via OLS with robust standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Constants are not reported.

6 Cost and exchange rate pass-throughs along the global supply chain

The regressions above, as it is common in synchronization analysis, have the correlation between inflation rates as dependent variable. As an additional analysis, in this section the level of sectoral inflation is the dependent variable and I analyze separately two types of shocks which can be transmitted via the supply chain: production cost and exchange rate shocks. More precisely, I examine how sectoral inflation rates react to changes in foreign producer prices and exchange rates along the supply chain. First, I build the foreign variables using the share of imported intermediate inputs as weights according to the following expressions:

$$\pi_{i,t}^{a*} = \sum_{b \neq a} \sum_{j} w_{ij}^{ab} \pi_{j,t}^{b}, \tag{5}$$

$$\Delta e_{i,t}^{a*} = \sum_{b \neq a} w_{i}^{ab} \Delta e_{t}^{ab}, \tag{6}$$

where w_{ij}^{ab} is the share of imported inputs in sector i in country A coming from sector j in country B; $\pi_{j,t}^{b}$ is the PPI inflation rate in sector j in country B; w_{i}^{ab} is the share of imported inputs in sector i in country A coming from country B, as the exchange rate is the same for different sectors inside the same country; and Δe_{t}^{ab} is the percentage depreciation of the currency of country A vis-à-vis the currency of country B. I estimate the following equation via pooled OLS with standard errors clustered at the sectoral level:

$$\pi_{i,t}^{a} = \alpha + \beta_p \pi_{i,t}^{a*} + \beta_e \Delta e_{i,t}^{a*} + \boldsymbol{\Phi I(i \times t)} + \epsilon_{i,t}^{a}, \tag{7}$$

where $\pi_{i,t}^{a}$ is the mom PPI inflation rate in sector i in country A in month t; $\pi_{i,t}^{a*}$ is the mom foreign PPI inflation rates relative to sector i in country A built according to equation (5); $\Delta e_{i,t}^{a*}$ is the mom percentage change in sector i's effective exchange rate built according to equation (6); and $\boldsymbol{I(i \times t)}$ are sector-time fixed effects. When country-specific industrial production growth rates are included in the model, they turn out not to be significant. In a particular specification I include CPI inflation in country A, $\pi_t^{a,CPI}$, to control for country-wide inflationary pressures. There are endogeneity issues with the specification of equation (7): shocks to producer prices in a sector in a country appear as dependent and as independent variable and there may be global shocks affecting inflation rates in different countries and sectors simultaneously. One solution would be to estimate a GVAR, but this is not possible given the large dimensionality of the data (40 countries x 14 sectors). The endogeneity issue is mitigated by the inclusion of sector-time fixed effects.

Table 4 reports the results from the estimation of equation (7). Sectoral producer price inflation is positively associated with production costs in the foreign sectors from which inputs are imported and with the exchange rate of the countries from which inputs are imported. The inclusion of sector-time fixed effects reduces considerably the effect of changes in producer prices abroad on changes in domestic producer prices (Column (1) vs Column (4)). Controlling for sector-time fixed effects, Column (4) in Table 4 shows that a 1% increase in foreign producer prices is associated with a 0.15% increase in domestic sectoral producer prices. Similarly, a 1% increase in the effective exchange rate (i.e., a 1% depreciation) is related to a 0.11% increase in domestic sectoral producer prices. Column (5) reports that the pass-through estimates do not change, if I control for country-wide inflationary pressures. Column (6) and column (7) show the results with the sample divided into sectors which have a below median use of imported inputs and sectors which have an above median use, respectively. As expected, sectors with a higher imported input intensity react much stronger to changes in producer prices along the global supply chain and they also react stronger to changes in the exchange rate.

There is a vast literature on exchange rate pass-throughs (e.g., Campa and Goldberg, 2005), in which estimates of pass-through vary substantially across countries and methodologies. My analysis differs from existing studies in three ways. First, I use trade in intermediate inputs instead of overall trade to calculate foreign weights. Second, I build foreign producer prices in a more granular way by considering prices in each cross-border sector which is an intermediate input supplier. Third, I do not relate changes in import prices to changes in exchange rates but rather changes in producer prices to changes in producer prices abroad and in exchange rates. Despite this, the magnitude of my results is in line with previous studies. Using a sample of Asia-Pacific countries and weights based on intermediate input trade, Auer and Mehrotra (2014) show that the pass-through of import prices to PPI inflation is of 0.21. Changes in import prices reflect, among others, changes in producer prices in local currency and changes in exchange rates.

Table 4: Regression Results

				Dependent variable: $\pi^{a*}_{i,t}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
						IO < med	IO > med
$\pi^{a*}_{i,t}$	0.68***	0.15***		0.15***	0.15***	0.09*	0.31***
(weighted by input share)	(0.12)	(0.02)		(0.02)	(0.02)	(0.05)	(0.11)
$\Delta e^{a*}_{i,t}$	0.10***		0.11***	0.11***	0.10***	0.10**	0.13***
(weighted by input share)	(0.01)		(0.02)	(0.02)	(0.02)	(0.03)	(0.02)
$\pi^{a,CPI}_{t}$					0.16***		
					(0.02)		
$\boldsymbol{I(i \times t)}$		Yes	Yes	Yes	Yes	Yes	Yes
# obs	60,802	60,802	60,802	60,802	60,802	31,609	29,193
R^2	0.10	0.44	0.46	0.46	0.46	0.55	0.27

The equation is estimated via pooled OLS with standard errors clustered at the sector level. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. The constants are not reported.

7 Conclusion

This paper studies whether trade in intermediate inputs is an important source of inflation synchronization across countries. First, estimating a Factor-Structural VAR, I find that cross-border price spillovers account for 20-30%

of domestic inflation fluctuations. Then, using a dataset on inflation and trade in intermediate inputs at the sectoral level for an extensive sample of countries, I show that cross-border sectors that use each other more as intermediate inputs exhibit a higher inflation correlation. This indicates that there are price spillovers along the global supply chain. Finally, I find that a 1% increase in producer prices of foreign intermediate input suppliers is associated with a 0.15% increase in domestic sectoral producer prices. Similarly, a 1% depreciation of the domestic currency vis-à-vis the currency of a sector's intermediate input suppliers increases domestic sectoral inflation by 0.11%. These cross-border price spillovers suggest that policy makers should assess domestic inflation in a global context.

Appendix

Table A.5: Correlation of PPI inflation rates (2002:M01-2014:M12)

	AUS	AUT	BEL	BGR	BRA	CAN	CHN	CYP	CZE	DEU	DNK	ESP	EST	FIN	FRA	GBR	GRC	HUN	IDN	IND	IRL	ITA	JPN	KOR	LTU	LUX	LVA	MEX	MLT	NLD	POL	PRT	ROM	RUS	SVK	SVN	SWE	TUR	TWN	USA
AUS	1.00																																							
AUT	0.60	1.00																																						
BEL	0.67	0.82	1.00																																					
BGR	0.70	0.87	0.87	1.00																																				
BRA	0.16	0.15	0.30	0.23	1.00																																			
CAN	0.67	0.61	0.66	0.60	0.20	1.00																																		
CHN	0.65	0.86	0.83	0.80	0.25	0.62	1.00																																	
CYP	0.52	0.67	0.76	0.81	0.30	0.45	0.60	1.00																																
CZE	0.60	0.82	0.82	0.74	0.17	0.68	0.77	0.58	1.00																															
DEU	0.84	0.74	0.81	0.85	0.23	0.69	0.72	0.75	0.68	1.00																														
DNK	0.66	0.69	0.84	0.81	0.26	0.54	0.79	0.68	0.61	0.76	1.00																													
ESP	0.70	0.85	0.92	0.92	0.18	0.69	0.83	0.79	0.80	0.89	0.86	1.00																												
EST	0.59	0.39	0.47	0.49	0.16	0.35	0.38	0.32	0.57	0.56	0.36	0.52	1.00																											
FIN	0.70	0.82	0.82	0.90	0.06	0.61	0.79	0.67	0.65	0.82	0.87	0.91	0.43	1.00																										
FRA	0.70	0.83	0.90	0.90	0.25	0.70	0.81	0.78	0.79	0.88	0.85	0.97	0.57	0.91	1.00																									
GBR	0.70	0.73	0.79	0.80	0.07	0.56	0.78	0.72	0.62	0.80	0.90	0.86	0.26	0.84	0.80	1.00																								
GRC	0.60	0.74	0.82	0.86	0.14	0.55	0.79	0.74	0.65	0.75	0.90	0.92	0.41	0.90	0.90	0.86	1.00																							
HUN	0.54	0.74	0.69	0.79	0.19	0.42	0.68	0.78	0.61	0.72	0.56	0.71	0.38	0.63	0.67	0.62	0.62	1.00																						
IDN	0.72	0.57	0.55	0.70	0.03	0.47	0.59	0.51	0.56	0.59	0.73	0.65	0.41	0.70	0.63	0.79	0.71	0.45	1.00																					
IND	0.40	0.71	0.64	0.63	0.14	0.66	0.64	0.59	0.66	0.59	0.49	0.69	0.27	0.63	0.72	0.51	0.60	0.57	0.35	1.00																				
IRL	0.14	0.08	0.10	0.08	-0.51	0.31	-0.17	0.10	0.09	0.14	-0.03	0.12	-0.06	0.12	0.06	0.10	-0.01	0.05	0.04	0.05	1.00																			
ITA	0.69	0.82	0.89	0.92	0.22	0.61	0.80	0.83	0.76	0.86	0.84	0.96	0.59	0.88	0.96	0.80	0.92	0.73	0.63	0.68	0.05	1.00																		
JPN	0.81	0.54	0.52	0.60	0.03	0.68	0.63	0.34	0.56	0.65	0.62	0.61	0.47	0.71	0.64	0.63	0.61	0.31	0.75	0.50	0.02	0.58	1.00																	
KOR	0.56	0.77	0.75	0.73	0.33	0.70	0.83	0.68	0.73	0.68	0.66	0.73	0.11	0.62	0.68	0.76	0.64	0.71	0.53	0.67	-0.02	0.66	0.52	1.00																
LTU	0.66	0.84	0.81	0.92	0.13	0.60	0.72	0.82	0.77	0.83	0.78	0.91	0.51	0.87	0.90	0.82	0.83	0.75	0.72	0.66	0.17	0.88	0.60	0.70	1.00															
LUX	0.78	0.65	0.79	0.77	0.24	0.59	0.70	0.76	0.67	0.83	0.69	0.79	0.59	0.70	0.78	0.72	0.70	0.76	0.61	0.62	0.03	0.81	0.63	0.67	0.76	1.00														
LVA	0.65	0.69	0.54	0.72	0.07	0.47	0.52	0.61	0.70	0.67	0.42	0.64	0.66	0.57	0.63	0.53	0.48	0.66	0.63	0.50	0.09	0.64	0.55	0.53	0.81	0.69	1.00													
MEX	0.34	0.47	0.49	0.49	0.40	0.38	0.52	0.62	0.44	0.42	0.35	0.45	0.16	0.23	0.40	0.42	0.40	0.68	0.25	0.48	-0.17	0.50	0.11	0.67	0.42	0.58	0.41	1.00												
MLT	0.38	0.15	0.20	0.30	-0.05	0.18	0.07	0.38	-0.07	0.42	0.21	0.20	-0.13	0.25	0.14	0.34	0.13	0.42	0.17	0.08	0.39	0.16	0.12	0.28	0.25	0.41	0.20	0.25	1.00											
NLD	0.72	0.82	0.87	0.91	0.22	0.64	0.81	0.73	0.73	0.88	0.86	0.96	0.60	0.92	0.96	0.82	0.91	0.65	0.66	0.62	0.01	0.95	0.65	0.63	0.88	0.75	0.64	0.37	0.15	1.00										
POL	0.36	0.74	0.68	0.65	0.15	0.56	0.66	0.61	0.78	0.55	0.42	0.66	0.21	0.45	0.59	0.52	0.50	0.75	0.30	0.65	0.12	0.62	0.20	0.78	0.63	0.56	0.57	0.74	0.16	0.54	1.00									
PRT	0.67	0.81	0.91	0.87	0.22	0.65	0.82	0.72	0.76	0.84	0.88	0.95	0.47	0.87	0.93	0.83	0.89	0.61	0.61	0.59	0.11	0.92	0.56	0.68	0.82	0.67	0.49	0.35	0.13	0.93	0.57	1.00								
ROM	0.17	0.06	0.30	0.22	0.53	0.01	0.26	0.29	0.21	0.22	0.28	0.19	0.35	0.00	0.18	0.14	0.21	0.31	0.08	-0.18	-0.33	0.23	-0.10	0.22	0.12	0.27	0.09	0.38	-0.01	0.19	0.16	0.26	1.00							
RUS	0.59	0.67	0.78	0.75	0.43	0.55	0.88	0.59	0.72	0.63	0.79	0.76	0.44	0.65	0.74	0.69	0.78	0.58	0.60	0.47	-0.28	0.77	0.57	0.73	0.63	0.65	0.44	0.53	-0.06	0.76	0.54	0.79	0.51	1.00						
SVK	0.50	0.29	0.50	0.55	0.45	0.21	0.33	0.68	0.34	0.68	0.49	0.54	0.58	0.38	0.55	0.45	0.47	0.59	0.33	0.22	-0.15	0.59	0.17	0.33	0.54	0.68	0.51	0.48	0.31	0.56	0.31	0.48	0.61	0.45	1.00					
SVN	0.45	0.64	0.66	0.71	0.43	0.38	0.62	0.62	0.67	0.53	0.54	0.62	0.53	0.50	0.61	0.48	0.56	0.68	0.47	0.35	-0.15	0.63	0.29	0.60	0.69	0.60	0.68	0.53	0.09	0.60	0.60	0.56	0.62	0.68	0.59	1.00				
SWE	0.71	0.58	0.58	0.73	0.28	0.39	0.63	0.54	0.35	0.64	0.68	0.61	0.41	0.66	0.56	0.63	0.62	0.64	0.64	0.25	-0.06	0.61	0.52	0.49	0.60	0.66	0.53	0.48	0.44	0.64	0.33	0.56	0.31	0.60	0.52	0.58	1.00			
TUR	0.04	-0.18	0.03	-0.01	0.45	0.05	-0.08	0.03	-0.05	-0.01	0.07	-0.04	0.14	-0.12	0.01	-0.11	0.04	-0.01	-0.05	-0.24	-0.10	0.00	-0.14	-0.04	-0.06	0.00	-0.12	0.10	0.00	-0.04	-0.09	-0.02	0.66	0.13	0.36	0.39	0.12	1.00		
TWN	0.52	0.70	0.68	0.67	0.23	0.54	0.82	0.45	0.68	0.51	0.66	0.71	0.51	0.69	0.72	0.55	0.77	0.55	0.54	0.60	-0.23	0.75	0.59	0.57	0.58	0.62	0.43	0.50	-0.10	0.72	0.53	0.66	0.22	0.78	0.25	0.58	0.57	0.08	1.00	
USA	0.65	0.81	0.83	0.82	0.18	0.70	0.90	0.65	0.76	0.76	0.87	0.90	0.40	0.87	0.90	0.85	0.91	0.55	0.69	0.69	-0.08	0.88	0.72	0.76	0.79	0.69	0.50	0.41	0.02	0.89	0.56	0.89	0.14	0.83	0.34	0.52	0.55	-0.09	0.80	1.00

Table A.6: Inflation Variance decomposition
Estimation period 2002:M01-2014:M12

	h (months)	Int shocks	Own shock	Spillover		h (months)	Int shocks	Own shock	Spillover
CN	1	0.09	0.91	0.00	KO	1	0.17	0.83	0.00
CN	2	0.15	0.80	0.06	KO	2	0.23	0.72	0.05
CN	4	0.18	0.62	0.21	KO	4	0.28	0.52	0.20
CN	8	0.18	0.50	0.32	KO	8	0.29	0.34	0.37
DE	1	0.11	0.89	0.00	JP	1	0.05	0.95	0.00
DE	2	0.14	0.82	0.03	JP	2	0.09	0.87	0.04
DE	4	0.20	0.66	0.14	JP	4	0.13	0.75	0.13
DE	8	0.26	0.44	0.30	JP	8	0.15	0.61	0.23
FR	1	0.10	0.90	0.00	US	1	0.21	0.79	0.00
FR	2	0.11	0.87	0.02	US	2	0.21	0.73	0.06
FR	4	0.14	0.78	0.08	US	4	0.21	0.64	0.15
FR	8	0.16	0.70	0.15	US	8	0.20	0.57	0.22

Table A.7: Regression Results

Dependent variable: cross-border sectoral inflation correlation (PPI, mom, 2002:M01-2014:M12)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9) w/o EMU-pairs	(10) w/o 0
IO	3.65***	3.81***	1.06***	1.11	-1.04**	0.31	1.37***	1.23***	0.63***	0.68***
	(0.27)	(0.27)	(0.18)	(0.93)	(0.44)	(0.22)	(0.18)	(0.18)	(0.20)	(0.17)
IO × elasticity of substitution				-0.08						
				(1.23)						
IO × $I_{(s_i==s_j)}$					2.45***					
					(0.48)					
IO × $I_{(\text{dev. country-pair})}$						1.40***				
						(0.33)				
$I_{(s_i==s_j)}$					0.16***					
					(0.01)					
$I_{(\text{dev. country-pair})}$						-0.07***				
						(0.01)				
$(X_i^{ab} + X_j^{ba})/(Y_a + Y_b)$							-26.76***			
							(2.79)			
$(X_i^{ab} + X_j^{ba})/(X_a + M_a + X_b + M_b)$								-2.89***		
								(0.55)		
Fixed effects										
$c_a + c_b + s_i + s_j$	Yes									
$c_a \times s_i + c_b \times s_j$		Yes								
$c_a \times c_b + s_i \times s_j$			Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# obs	82,795	82,795	82,795	82,795	82,795	82,795	82,795	82,795	72,333	46,668
R^2	0.15	0.24	0.29	0.29	0.29	0.29	0.29	0.29	0.26	0.37

The equation is estimated via OLS with robust standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Constants are not reported.

References

ARTIS, M., G. CHOULIARAKIS, AND P. K. G. HARISCHANDRA (2011): "Business Cycle Synchronization since 1880," *The Manchester School*, 79, 173–207.

AUER, R. A. AND A. MEHROTRA (2014): "Trade Linkages and the Globalisation of Inflation in Asia and the Pacific," *forthcoming in the Journal of International Money and Finance.*

AUER, R. A. AND P. SAURÉ (2013): "The globalisation of inflation: a view from the cross section," *Bank for International Settlements Papers No 70.*

BERNANKE, B. S. (2007): "Globalization and Monetary Policy," *Speech at the Fourth Economic Summit, Stanford Institute for Economic Policy Research, Stanford, California. March 2, 2007.*

BORIO, C. AND A. FILARDO (2007): "Globalisation and inflation: New cross-country evidence on the global determinants of domestic inflation," *BIS Working Papers No. 227.*

CALDERON, C., A. C. CHONG, AND E. STEIN (2007): "Trade Intensity and Business Cycle Synchronization: Are Developing Countries Any Different?" *Journal of International Economics*, 71, 2–21.

CAMPA, J. M. AND L. GOLDBERG (2005): "Exchange Rate Pass-Through into Import Prices," *Review of Economics and Statistics*, 87, 679–690.

CICCARELLI, M. AND B. MOJON (2010): "Global Inflation," *The Review of Economics and Statistics*, 92, 524–535.

CLARK, T. E. AND K. SHIN (2000): "The Sources of Fluctuations within and across Countries," *In Intranational Macroeconomics, edited by Gregory Hess and Eric van Wincoop Cambridge University Press.*

DI GIOVANNI, J. AND A. LEVCHENKO (2010): "Putting the Parts Together: Trade, Vertical Linkages, and Business Cycle Comovement," *American Economic Journal: Macroeconomics*, 2, 95–124.

Diebold, F. X. and K. Yilmaz (2015): “Measuring the Dynamics of Global Business Cycle Connectedness,” *in S.J. Koopman and N. Shephard (eds.), Unobserved Components and Time Series Econometrics: Essays in Honor of Andrew C. Harvey, Oxford University Press, in press.*

Ferroni, F. and B. Mojon (2014): “Domestic and Global Inflation,” *Mimeo.*

Gilchrist, S., R. Schoenle, J. Sim, and E. Zakrajsek (2015): “Financial Heterogeneity and Monetary Union,” *March 2015, mimeo.*

Goldberg, L. and J. Campa (2010): “The sensitivity of the CPI to exchange rates: distribution margins, imported inputs, and trade exposure,” *Review of Economics and Statistics*, 92, 392–407.

Kimball, M. S. (1995): “The Quantitative Analytics of the Basic Neomonetarist Model,” *Journal of Money, Credit and Banking*, 27, 1241–1277.

Luong, T. A. (2011): “The Impact of Input and Output Tariffs on Firms? Productivity: Theory and Evidence,” *Review of International Economics*, 19, 821–835.

Martin, J. (2011): “Globalization of Inflation: Micro Evidence on the Imported Input Channel,” *Mimeo.*

Monacelli, T. and L. Sala (2009): “The International Dimension of Inflation: Evidence from Disaggregated Consumer Price Data,” *Journal of Money, Credit and Banking*, 41, 101–120.

Mumtaz, H. and P. Surico (2008): “Evolving international inflation dynamics: evidence from a time-varying dynamic factor model,” *Bank of England Working Papers No. 341.*

Ng, E. C. Y. (2010): “Production Fragmentation and Business Cycle Comovement,” *Journal of International Economics*, 82, 1–14.

Stock, J. and M. Watson (2005): "Understanding Changes in International Business Cycle Dynamics," *Journal of the European Economic Association*, 3, 968–1006.

Timmer, M. P., E. Dietzenbacher, B. Los, R. Stehrer, and G. J. de Vries (2015): "An Illustrated User Guide to the World Input? Output Database: the Case of Global Automotive Production," *Review of International Economics*, 23, 575–605.

Wang, P. and Y. Wen (2007): "Inflation dynamics: A cross-country investigation," *Journal of Monetary Economics*, 54, 2004–2031.

Wong, C. and Y. Eng (2013): "International business cycle comovement and vertical specialization reconsidered in multistage Bayesian DSGE model," *International Review of Economics and Finance*, 26, 109–124.