How do Real and Monetary Integrations Affect Inflation Dynamics in Turkey?

Hülya Saygılı

August 2021
Working Paper No: 21/21

TÜRKİYE CUMHURİYET
MERKEZ BANKASI

Address:

Central Bank of the Republic of Turkey

Head Office

Structural Economic Research Department

Hacı Bayram Mah. İstiklal Caddesi No: 10

Ulus, 06050 Ankara, Turkey

Phone:

+90 312 507 80 04

Facsimile:

+90 312 507 78 96

How do real and monetary integrations affect inflation dynamics in Turkey?

Hülya Saygılı[1]

Abstract

This paper examines the significance of real and monetary integrations among countries on the inflationary dynamics of an emerging country, Turkey. The analysis accounts for 2-digit items of CPI inflation which can be broadly categorized as tradable/non-tradable and goods/services. The results show that fall in inflation gap between the partners is mainly related with the real integration while co-movement of inflation is prominently driven by the monetary policy co-movement. The product type analysis documents that inflation gap in tradable items shrinks and become more correlated with the convergence and co-movement of real variables.

Özet

Bu çalışma, ülkeler arasındaki gerçek ve parasal bütünleşmelerin gelişmekte olan bir ülkenin, Türkiye'nin enflasyonist dinamikleri üzerindeki önemini incelemektedir. Analiz, genel olarak ticarete konu olan/ticarete konu olmayan ve mal/hizmet olarak sınıflanabilecek 2 haneli TÜFE enflasyon kalemlerini dikkate almaktadır. Bulgular, ortaklar arasındaki enflasyon açığındaki düşüşün esas olarak reel bütünleşme ile ilişkili, enflasyonun birlikte hareketinin ise para politikası işbirliğiyle belirgin bir şekilde etkilendiğini göstermiştir. Ürün tipi analizi, ticarete konu olan kalemlerdeki enflasyon açığının küçüldüğünü ve reel değişkenlerin yakınsaması ve birlikte hareketi ile daha ilişkili hale geldiğini belgelemektedir.

Keywords: Globalization, Inflation gap, Co-movement, CPI sub-items, Turkey.

JEL Classification: E31, F14, F4

[1] Central Bank of the Republic of Turkey. Structural Economic Research Department. İstiklal Cad. No.10 06100 Ulus/Ankara, TURKEY. E-mail: hulya.saygili@tcmb.gov.tr.
The views and opinions presented in this paper are those of the author and do not necessarily represent those of the Central Bank of the Republic of Turkey or its staff. Author thanks to the anonymous referee and the Editor for the constructive comments and recommendations which help to improve the final version of the paper

Non-technical Summary

The inflationary linkages across countries have become one of the most debated issue in recent years and the current agenda has been shifted on the factors leading such an interrelationship. Understanding the nature of the linkage is important for policy makers to implement appropriate policies coordinated with the international developments.

Within the context of international production linkages, countries specialize in different stages of a production process and exchange goods that are used as intermediate inputs. Any shock to domestic production is likely to be transferred to partner countries through such input-output linkages, initiating co-movement of inflation. In the meantime, integration reallocates production efficiently towards countries where costs are lower, so that the production cost gap between them is likely to decrease. The literature provides evidence of the effects of input-output linkages on the co-movement of inflation, but there is a lack of studies on the inflation gap issue. This paper focuses on the different impact of value-added trade, as an indicator for input-output linkages, along with the ongoing monetary integration and integration of markets on both inflation gap and co-movement of inflation.

In contrast to the existing literature, which mainly focuses on developed countries we study an emerging country Turkey, with well-developed trade linkages. Rather than using aggregate data, we use 12 2-digit consumer price index (CPI) items which can also be grouped according to their tradability (tradable/ non-tradable) and product types (goods/services). Each of these items may exposed to different levels of international demand and supply shocks and display dissimilar responses. Also we use the Trade in Value Added (TiVA) database, which allows tracking of intermediate inputs as they cross geographical boundaries and industrial processing stages on their way to foreign and possibly domestic final demands to compute bilateral value-added trade for three sub-sectors: Agriculture, industry and services.

We find that reduction in inflation gap is significantly related with real integration while co-movement of inflation is prominently driven by the co-movement in monetary policy. Product type analysis reveals that, inflation gap in tradable items decrease at a significant rate and become more correlated with the convergence and co-movement of real variables between the trade partners.

Introduction

The inflationary linkages across countries have become one of the most debated issue in recent years (see, e.g. Ciccarelli and Majon 2010, Neely and Rapach, 2011, Mumtaz et al. 2011, Mumtaz and Surico 2012, Eichmeier and Pijenburg 2013, Förster and Tillmann 2014 and Brož and Kočenda 2018, Ha et al., 2019). The current agenda is focused on the factors behind international inflationary linkages. The significance of the factors such as common structural shocks, implementation of similar economic policies, real and financial integration has been examined as determinants of globalized inflation. Understanding the nature of the linkage is important for policy makers to implement appropriate policies coordinated with international developments.

This paper attempts to contribute the literature on globalization and inflation by examining the role expansion of production linkages plays in linking inflationary dynamics between countries. Within the context of international production linkages, countries specialize in different stages of a production process and exchange goods that are used as intermediate inputs in domestic production. Consequently, components move across borders multiple times until the production is completed, resulting in a complex flow of value added across countries. In the meantime, such a structural integration of production, leads domestic macroeconomic dynamics to become more sensitive to international disturbances.

Any shock to domestic production is likely to be transferred to partner countries through such input-output linkages, initiating co-movement of domestic inflation. In fact, depending on the extent of the production networks, local shocks are likely to be transformed into a global inflationary process. The open economy literature provides a large research resource on the relationship between external shocks and domestic inflation. In most of these studies significance of trade openness or global slack variables are tested as determinants of inflationary linkages.

Recently, Auer and Mehrotra (2014), Auer, Levchenko and Saure (2017), Auer, Borio and Filardo (2017) and Saygılı (2019) empirically examined impact of intermediate goods trade as an indicator for growing structural production integration on the domestic inflation dynamics. Auer, Borio and Filardo (2017) also investigate the role growth of global value chain can play in explain the increasing global nature of domestic inflation, while Saygılı (2019) shows that impacts of domestic and external factors on domestic inflation depend on the degree of integration into the global value chains.

There is another inflationary dynamic arising from the formation of structural production linkages. Integration reallocates production efficiently towards countries where costs are lower (Acemoglu, Gancia and Zilibotti 2012). Accordingly, the production cost gap between the pair of countries that integrate their production processes is expected to decrease gradually (Grossman and Rossi-Hansberg 2008, Baldwin and Robert-Nicoud 2014), which eventually may cause inflation gap between them to go down.[2]

The literature provides evidence of the effects of input-output linkages on the co-movement of inflation, but there is a lack of studies on the convergence issue. This paper examines the relative importance of real and nominal integration on both falling inflation gap and co-movement of inflation between trade partners. In particular it focuses on the differing impact of value-added trade, as an indicator for global production sharing or input-output linkages, along with the ongoing monetary integration and integration of markets on both inflation gap and co-movement

[2] Jones and Kierzkowski (1990) are regarded to be the first to note that production fragmentation may have complex wage effects. Feenstra and Hanson (2003), Egger and Egger (2002), Egger and Pfaffermayr (2004), Egger (2006), Geishecker and Görg (2008) and Saygılı (2017) empirically investigate the link between production fragmentation and wage convergence.

of inflation. This is an important question to understand the nature of the linkage between inflationary dynamics and trade.

Second, consumer price index (CPI) is constituted of many heterogeneous goods and services that are classified in 12 2-digit items. These items may also be grouped according to their tradability (tradable vs non-tradable) and product types (goods vs services). Each of these items may be exposed to different levels of international demand and supply shocks and may display dissimilar responses to those shocks. Due to that monetary authorities often monitor developments in the components of CPI individually. Accordingly, in contrary to the literature which focuses on aggregate inflation, we believe that working with disaggregated data would deepen our understanding of inflation dynamics. Earlier, Altansukh et al. (2017) studied the globalization of CPI inflation by analyzing core, energy and food components. Our study adds to their approach by accounting for further detailed CPI data.[3]

Following Auer, Borio and Filardo (2017) and Saygılı (2019) we argue that value added trade is a proper indicator to reflect the nature of production linkages. Accordingly, we use the Trade in Value Added (TiVA) database, formed from the OECD/WTO national input-output tables. TiVA data allows tracking of intermediate inputs as they cross geographical boundaries and industrial processing stages on their way to foreign and possibly domestic final demands. Unlike Auer, Borio and Filardo (2017) and Saygılı (2019) we form a bilateral TiVA indicator to adequately measure the contribution of each partner to value-added in domestic production. Also, we compute bilateral value-added trade for three sub-sectors: Agriculture, industry and services. This is an important detail in our analysis since not only the contribution of each partner to value

[3] Auer and Mehrotra (2014) and Auer Borio and Filardo (2017) use producer prices rather than CPI to account for sectoral differences in trade and production linkages. In Saygılı (2019) dependent variable is the annual rate of change in the sectoral output deflator.

added in production vary from sector to sector, but also the volume of value-added trade may vary indicating different level of production integration across the sectors.

In contrast to the existing literature, which mainly focuses on developed countries we study an emerging country Turkey, with well-developed trade linkages. From their examination of the inflation volatility, Bowdler and Malik (2017) have shown that impact of openness is likely to be stronger amongst developing and emerging countries. Auer and Mehrotra (2014) note the scarcity of studies on these countries. Among those Baldwin and López-González (2013) and Auer and Mehrotra (2014) investigates the impact of real integration on the co-movement of prices in Asia. To add this literature we use Turkey as a case study. According to the OECD-WTO TiVA database Turkey's GVC participation index (percentage share in total gross exports) increased by 8.4 % from 2005 to 2015. [4] This increase was higher than the average for both developed (4.1 %) and developing (6.5 %) countries. Pomfret and Sourdin (2018) reported similar findings: value-chain and network trades have grown rapidly in emerging markets, with Turkey displaying above-average performance among emerging European countries.

We find that reduction in inflation gap is significantly related with real integration while co-movement of inflation is prominently driven by the co-movement in monetary policy. Product type analysis reveals that, inflation gap in tradable items decrease at a significant rate and become more correlated with the convergence and co-movement of real variables between the trade partners.

[4] https://www.wto.org/english/res_e/statis_e/miwi_e/all_Profiles_e.pdf

2. Empirical Analysis

2.1. Model

The estimated models are of the forms:

$$Iqr\_i_{hpt} = \theta_0 + \alpha_1 * va_{hpt} + \gamma_1 * Iqr\_mon_{hpt} + \gamma_2 * Iqr\_gap_{hpt} + \gamma_3 * Iqr\_prd_{hpt} + \beta * Z_{hpt} + \varepsilon_t, \quad (1.a)$$

$$Cor\_i_{hpt} = \theta_0 + \alpha_1 * va_{hpt} + \gamma_1 * Cor\_mon_{hpt} + \gamma_2 * Cor\_gap_{hpt} + \gamma_3 * Cor\_prd_{hpt} + \beta * Z_{hpt} + \varepsilon_t, \quad (1.b)$$

The first equation is used to investigate inflation gap (Iqr_i_{hpt}), and the second equation to co-movement of inflation (Cor_i_{hpt}) in the CPI item i between home (h) and partner countries (p) at time t. Bilateral trade in values added (va_{hpt}) is included into the models to examine the impact of bilateral production integration on domestic price dynamics. Also, following Auer and Mehrotra (2014) estimated equations account for the developments in monetary policy (mon_{hpt}), output gap (gap_{hpt}) and productivity growth (prd_{hpt}) in home and partner countries. Monetary policy captures the monetary nature of inflation, while output gap reflects business cycle effects and productivity growth accounts for productivity shocks between the partner countries. Computation of these indicators are explained in details below.

Inflation targeting is the common monetary regime implemented by the sample of countries used in this study during the analysis period. Accordingly monetary policy rates are used to compute convergence and correlation aspects of the monetary policies implemented in home and partners. Output gap is attained using Prescott-Hodrick filtering methodology. Productivity is measured as a ratio of output to labor cost. Both output gap and productivity growth are further detailed at sector levels as agriculture, manufacturing and services.

Finally, vector Z_{hpt} includes country and CPI items dummies. Parameters $\theta_0, \alpha_1, \gamma_1, \beta$ are the coefficients to be estimated while ε_t is the i.i.d error term.

2.2. Measurements of Variables, Data and Descriptive Statistics

2.2.1. Convergence

There are alternative indicators frequently used in the literature to represent concept of convergence (or dispersion) in empirical analyses.[5] The interquartile range *(Iqr),* based on the division of a data set into quartiles, is one of the commonly used indicator to measure convergence. *Iqr* is computed as a difference between the middle values of the upper (q3) and lower (q1) quartile ranked-ordered data set. Since Iqr accounts for the middle half of the data, it is less influenced by outliers and avoids bias inherent in the mean.

$$Iqr_{hpt} = q3_{hpt} - q1_{hpt}$$

Here, *h, p* and *t* denote for home, partner and period. A decrease in the values of Iqr_{hpt} indicates convergence in variables of interest between home and partner.

2.2.2. Co-movement

Following the literature co-movement is represented by the correlation coefficient(Cor_{hpt}) statistics, which indicates the strength of the relationship between two variables. The values of

[5] The coefficient of variation *(CV)* is the standard deviation as a percentage of the mean. It has the advantage of standardizing across data with different means, but is exposed to outliers as they affect both standard deviation and the mean. The principle component analysis *(PCA)* is another commonly used indicator measuring convergence/ divergence. It is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of linearly uncorrelated variables. PCA is a meaningful indicator when the time dimension is long enough. Since our analysis is limited in terms of time dimension, we did not find it appropriate to use PCA.

Cor_{hpt} varies between -1 and 1; those close to -1 indicates a strong negative relationship, whereas those close to 1 indicates a strong positive relationship.

Convergence and co-movement processes describes medium to long run behaviors. Due to that, as in Saygılı (2017) we adopt 3-year moving windows approach to form a panel data involving home-partner pairs and time dimension. To do that the first element of the moving series is obtained by computing the initial 3 years observation of home and partner. The indicators are modified by excluding the first year observation and including the next year observation. For instance, we compute Iqr_{hpt} between home and partner for the periods 2005-2007, 2006-2008, etc. By doing this, we would be able to capture medium to long-term trends in the convergence and co-movement period, and at the same time include both cross sectional and time dynamics into our models. The 3-year moving window approach not only allows us to capture rapidly changing patterns but also smooth out year-on-year unexpected changes.

2.2.3 Bilateral Value –Added Trade

Daudin, Rifflart and Schweisguth (2011), Koopman, Power, Wang and Wei (2010) and Johnson and Noguera (2012) state that value added trade better tracks global production networks and supply chains. Based on these studies OECD and WTO jointly compute and release "trade in value added (TiVA)" data to assess the intensity of international production networks.[6]

OECD TiVA database contains a range of indicators measuring the value added content of international trade flows and final demand. Indicators are computed by using input/output tables

[6] Feenstra and Hanson (1996) define the extent of fragmentation or specialization in production as "imported input embodied in gross output as a share of total gross output" to point out the rising trends in outsourcing. Hummels et al. (2001) define it as "a share of imported input embodied in its exported goods in total exports" to measure the growth of vertical specialization. Amador and Cabral (2009) suggest a relative measure which combines information from Input-Output matrices and international trade data for measuring the extent of vertical specialization.

for each country. Since we are interested in the linkage between home and partners' domestic CPI inflation, the indicator for bilateral value added trade is attained by dividing the sum of "value added embodied in domestic final demand (vah_{hpt})" and "domestic value added in foreign domestic final demand (vap_{pht})" to the sum of total value added in home and partner countries.

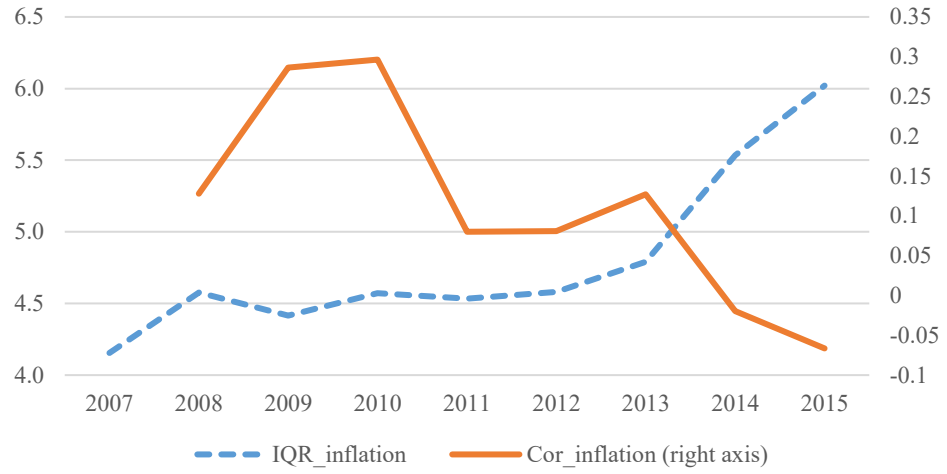
$$va_{hpt} = (vah_{hpt} + vap_{pht})/(va_{ht} + va_{pt})*100 \quad (2)$$

We compute bilateral value added trade for overall economy, $va_tot_{_hpt}$and for 3 sub industries: Agriculture (va_agr_{hpt}), manufacturing (va_man_{hpt}) and services (va_ser_{hpt}). Integration of markets in different industries may show different patterns due to factors specific to the each industries. For instance countries may be willing to act protective in agricultural industry relative to the manufacturing.

2.3. Data and Descriptive Statistics

CPI inflation data are taken from International Labor Organization Statistics (ILOSTAT). Analysis covers 12 2-digit sub-items of CPI. Time period and number of partner countries are limited by the availability of trade in value added data. Trade in value added data is available at annual basis for the period of 2005-2015. We focus on Turkey and 27 partner countries (26 from Europe and the USA).

Figure 1: Convergence and co-movement of inflation*



Note: Indicators were computed by averaging the values of Iqr_{hpt} and Cor_{hpt} between Turkey and partner countries.

Figure 1 indicates a falling trend in correlation coefficient, especially after 2010, indicating that on the average inflation in Turkey and partner countries moved in opposite directions. Convergence of inflation between Turkey and trade partner was more or less stable during 2008-2012, but as of 2013, there has been a diverging trend in overall inflation.

In Table 1, the average convergence rate in inflation vary within the range of 2.9-6.9 with the mean 4.8. The correlation coefficient also display highly volatile pattern between -0.15 and 0.60 with the mean 0.12. The correlation coefficient between the convergence and co-movement indicators is about 0.3, and implies that as the convergence rate increases, the co-movement of inflation slightly weakens.

Using Dixon et al (2004) and Johnson (2017), 2 digit CPI items can be grouped as tradable- vs non-tradable and goods vs services items. Accordingly, since most of the items in foods and non-alcoholic beverages, clothing and footwear, furnishing and household equipment,

transportation and communication are listed in tradable category we have grouped them as tradable items, and the others as non-tradable items. Similarly, as most of the items in foods and non-alcoholic beverages, alcoholic beverages, clothing and footwear, furnishing and household equipment and recreation and culture are listed in goods category we have grouped them as goods items, and the others as services items.

Table 1. Descriptive Statistics COICOP 01-12

	Iqr_inflation				Cor_inflation			
	Mean	SD	Min	Max	Mean	SD	Min	Max
01. Food and non-alcoholic beverages	6.449	2.014	2.078	11.978	0.024	0.827	-0.999	0.999
02. Alcoholic beverages, tobacco and narcotics	6.887	3.073	0.378	22.498	0.028	0.726	-0.997	0.999
03. Clothing and footwear	4.580	2.594	0.300	12.068	0.158	0.687	-0.999	0.999
04. Housing, water, electricity, gas and other fuels	4.783	2.289	0.505	11.118	0.273	0.672	-0.999	0.999
05. Furnishings, household equip. and routine household main.	4.837	2.296	0.460	10.213	0.184	0.658	-0.999	0.999
06. Health	2.379	1.697	0.140	10.268	-0.065	0.722	-0.999	0.999
07. Transport	5.154	1.815	0.300	8.948	0.596	0.530	-0.990	0.999
08. Communication	3.141	1.722	0.270	9.778	-0.154	0.718	-0.999	0.999
09. Recreation and culture	2.920	1.540	0.500	8.315	0.104	0.729	-0.999	0.999
10. Education	3.367	2.320	0.205	20.443	-0.001	0.779	-0.999	0.999
11. Restaurants and hotels	6.873	2.263	1.370	13.253	0.051	0.714	-0.999	0.999
12. Miscellaneous goods and services	6.201	2.125	1.400	10.870	0.245	0.711	-0.999	0.999
Average	4.797	2.146	0.659	12.479	0.120	0.706	-0.999	0.999
Tradable items	4.696	2.482	0.300	12.068	0.113	0.735	-0.999	0.999
Non-Tradable items	4.848	2.741	0.140	22.498	0.122	0.733	-0.999	0.999
Goods	5.134	2.753	0.300	22.498	0.097	0.733	-0.999	0.999
Services	4.557	2.562	0.140	20.443	0.135	0.734	-0.999	0.999

Source: ILOSTAT and our computations.
Both correlation coefficients and interquartile ranges are computed using 3-years of observation. Due to that min and max values are close to -1 and 1 respectively. However, for the regression analysis trend in the 3-year moving window is more relevant than the point value.

Bottom part of Table 1 documents some basic descriptive statistics about these groups. On the average convergence and correlation indicators for tradable items are lower than those for non-tradable items. That implies tradable items inflation has higher converging rate as it co-moves with

partner's inflation. The situation seems to be little bit more complex when we classify items as goods vs services types. Average values of the convergence indicator for services is lower than that for goods, suggesting that inflation in services items converges to those of partners at a higher rate. Also, services inflation is more correlated with inflation in partner countries as it has higher correlation value. This means that inflation in services increases in both partners in a way that the gap between them shrinks.

Table 2. Descriptive Statistics: Bilateral value-added trade (2005-2015)

	Obs.	Mean	S.D	Max	Min
Value added trade in total economy (va_tot_{hpt})	3,564	0.242	0.191	0.889	0.007
Value added trade in agriculture (va_agr_{hpt})	3,564	0.140	0.159	0.906	0.002
Value added trade in manufacturing (va_man_{hpt})	3,564	0.774	0.653	2.340	0.020
Value added trade in services (va_ser_{hpt})	3,564	0.113	0.089	0.460	0.004

Source: OECD

Table 2 reports that for the overall economy mean trade in value added is about 0.24 but it exhibits quite a variation from 0.00 to 0.89. Comparison of sub sectors indicates that bilateral trade in value added in manufacturing is about three times higher than the overall economy, but it exhibits highest variation(S.D=0.65). On the average, production integration is below the economy average in agriculture and services. Although, the extent of bilateral integration is the lowest in services, it does not show much variation between the trade partners.

2.3. Empirical Results

Value added trade data is available for 2005-2015 in OECD database. Since we use 3-year moving average approach to compute our indicators for convergence, in the empirical analysis,

time dimension starts at 2007 and ends at 2015.[7] All trade variable is measured by their corresponding years' values. Accordingly empirical analysis is conducted with panel data covering 27 partner countries, 12 2-digit CPI items and 9 years. However, number of observations may change from mode to model as we have unbalanced panel data.

2.3.1. How does globalization affect convergence and co-movement of inflation?

Results reported in Table 3 and 4 show that significance of value added trade depends on both sectors and inclusion of other control variables. Model 6 which includes trade, monetary policy, business cycle, and productivity growth related indicators performs better than the others. Considering Model 6, findings suggest that convergence of inflation is significantly related with the value-added trade in manufacturing, convergence in output gap in services and convergence in productivity growth in agriculture while co-movement of inflation is mainly associated with the correlated monetary policy rates.

Regarding the magnitude and sign of the estimated coefficients, a one standard deviation increase in manufacturing value added trade is associated with a 2.7 percentage point increase in the convergence of inflation. The estimated coefficients for the other trade related variables are not significant. Using the information from Table 2 it may be concluded that value added trade is likely to have expected impacts once the global production networks attain a certain levels of strengths.

Convergence of output gaps or business cycles implies that economic conditions in partner countries gets closer or similar to each other. If this is the case then inflation gap between them is

[7] Regression analyses were also conducted using 5-year moving average windows. However, in all cases the estimation results with 3-year moving averages were preferred. Results are available upon request.

expected to decrease. Increase in our indicator for convergence, interquartile range, indicates a divergence between two variables. When economies experience dissimilar business cycles then direction of inflation gap depends on the nature of the shocks in each partner. Results in Table 3 reports positive but insignificant results for agriculture and manufacturing. However, the estimated coefficient for output gap (de)convergence γ_{23} is significant and negative for services. Note that partner countries in our analysis are consist of EU members and the USA. After 2009-2010 financial crises, these countries entered a disinflationary period together with a negative output gap. At the meantime in Turkey prices were in a slight uptrend with a slightly positive output gap. Table 3 indicates that this effect is prominent in services.

Regarding the productivity growth, convergence implies that partner countries experience similar productivity shocks, in other words their production technologies are getting closer leading inflation gap to go down. Accordingly, increase in interquartile range of productivity growth implies dissimilarity in production technologies in partners. Once again the response of inflation gap depends on the direction of productivity changes. The estimated coefficients for productivity growth in Table 3 are all negative suggests that expansion in the productivity growth range in sectors contributes to falling inflation gap in all sectors but the impact is significant only in agriculture. Examination of productivity growth series in Turkey and partner countries reveals that after the 2009-2010 financial crisis, productivity gained an upward trend in partner countries but downward trend in Turkey. Investigation of productivity growth series in Turkey and partner countries reveals that after the 2009-2010 financial crises, there was an increasing trend in partner countries while in the trend is downward. Increase in productivity growth in partners coincides with the falling inflation rates, in Turkey decrease in productivity growth leads inflation to go up.

Table 3: Estimated results for inflation convergence (Equation 1.a)

Model	1	2	3	4	5	6
Bilateral value added trade						
Total (α_1)	5.104	3.903	2.974	1.255		
	(3.048)	(2.561)	(2.662)	(2.048)		
Agriculture (α_{11})					2.917	2.883
					(2.090)	(1.978)
Manufacturing (α_{12})					-2.877***	-2.718***
					(0.951)	(0.902)
Services (α_{13})					12.101	11.140
					(7.720)	(7.285)
Monetary policy (de)convergence (γ_1)		-0.032	-0.027	-0.047	-0.035	-0.005
		(0.062)	(0.061)	(0.054)	(0.058)	(0.055)
Output gap (de)convergence						
Total (γ_2)			-0.001	-0.001	-0.001	
			(0.001)	(0.001)	(0.001)	
Agriculture (γ_{21})						0.050
						(0.050)
Manufacturing (γ_{22})						0.002
						(0.003)
Services (γ_{23})						-0.005***
						(0.002)
Productivity growth (de)convergence						
Total (γ_3)				-12.266	-9.585	
				(8.406)	(7.520)	
Agriculture (γ_{31})						-6.814***
						(1.714)
Manufacturing(γ_{32})						-0.798
						(3.426)
Services(γ_{33})						-1.097
						(4.66)
N	2,916	2,892	2,892	2,784	2784	2,736
Adjuster R2	0.360	0.362	0.363	0.357	0.363	0.371

*, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively. Standard errors are in parenthesis.

Table 4: Estimated results for inflation co-movement (Equation 1.b)

Model	1	2	3	4	5	6
Bilateral value added trade						
Total (α_1)	-2.468*	-0.966	-0.864	-0.710		
	(1.226)	(0.859)	(0.826)	(0.820)		
Agriculture (α_{11})					-0.088	-0.188
					(0.611)	(0.497)
Manufacturing (α_{12})					-0.070	-0.098
					(0.291)	(0.281)
Services (α_{13})					-0.926	-0.733
					(2.359)	(2.011)
Monetary policy (de)convergence (γ_1)		0.156*	0.152*	0.148*	0.149**	0.162**
		(0.078)	(0.073)	(0.069)	(0.066)	(0.069)
Output gap (de)convergence						
Total (γ_2)			0.047	0.051	0.051	
			(0.093)	(0.101)	(0.106)	
Agriculture (γ_{21})						0.077
						(0.044)
Manufacturing (γ_{22})						-0.018
						(0.062)
Services (γ_{23})						0.021
						(0.108)
Productivity growth (de)convergence						
Total (γ_3)				0.038	0.038	
				(0.038)	(0.036)	
Agriculture (γ_{31})						-0.008
						(0.026)
Manufacturing(γ_{32})						0.020
						(0.038)
Services(γ_{33})						0.021
						(0.032)
N	2464	2,451	2,451	2,354	2,354	2,352
Adjuster R2	0.082	0.101	0.101	0.103	0.103	0.104

*, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively. Standard errors are in parenthesis.

On the co-movement of inflation, none of the real co-movement indicators are significant. In the case of Turkey, monetary policy correlation is found to be the unique significant factor behind the inflationary co-movement. The estimated coefficients are significantly positive and vary between 0.15 and 0.16.

2.3.2 Do the parameter estimates vary with respect to the trade structure and types of CPI items?

CPI is composed of 12 2-digit sub-items, each with different trade structure and product types. After, classifying items into two broad groups as tradable vs non-tradable and goods vs services, following Johnson (2017) and Dixon et al (2005), this section investigates if there are systematic similarities in the model estimates with respect to the types of CPI sub-items. To do that we define a CPI sub-item dummy D_i that takes the value of one if sub-item belong to the type i; otherwise zero. Then Equation 1 is modified as below to test how different effects are observed for the type i in contrast to the other.

$$Iqr\_i_{hpt} = \theta_0 + \alpha_1 * va_{hpt} + \gamma_1 * Iqr\_mon_{hpt} + \gamma_2 * Iqr\_gap_{hpt} + \gamma_3 * Iqr\_prd_{hpt} + \theta_1 * D_i + \alpha_2 * D_i * va_{hpt} + \gamma_4 * D_i * Iqr\_mon_{hpt} + \gamma_5 * D_i * Iqr\_gap_{hpt} + \gamma_6 * D_i * Iqr\_prd_{hpt} + \beta * Z_{hpt} + \varepsilon_t \quad (3.a)$$

$$Cor\_i_{hpt} = \theta_0 + \alpha_1 * va_{hpt} + \gamma_1 * Cor\_mon_{hpt} + \gamma_2 * Cor\_gap_{hpt} + \gamma_3 * Cor\_prd_{hpt} + \theta_1 * D_i + \alpha_2 * D_i * va_{hpt} + \gamma_4 * D_i * Cor\_mon_{hpt} + \gamma_5 * D_i * Cor\_gap_{hpt} + \gamma_6 * D_i * Cor\_prd_{hpt} + \beta * Z_{hpt} + \varepsilon_t \quad (3.b)$$

Here, $\alpha_1, \gamma_1, \gamma_2$ and γ_3 are the coefficient estimates for type other than i. Coefficients α_2, γ_4, γ_3 and γ_6 represent the differencing impacts for type i from the other. The estimated impacts for type i will be $\alpha^i{}_{va} = \alpha_1 + \alpha_2, \gamma^i{}_{mon} = \gamma_1 + \gamma_4$, $\gamma^i{}_{gap} = \gamma_2 + \gamma_5$ and $\gamma^i{}_{prd} = \gamma_3 + \gamma_6$. Then, the significance of the estimated coefficients for type i can be tested using F statistics.

Table 5: Estimation results for inflation convergence and co-movement for CPI sub-items

	Convergence of CPI		Co-movement of CPI	
CPI items	Tradable vs Non-tradable	Goods vs Services	Tradable vs Non-tradable	Goods vs Services
Bilateral value added trade				
Agriculture (α_{11})	3.069	1.320	-0.118	-0.275
	(1.777)	(1.798)	(0.394)	(0.480)
Manufacturing (α_{12})	-2.499***	-2.715***	-0.087	-0.090
	(0.965)	(0.879)	(0.293)	(0.292)
Services (α_{13})	10.791	14.630**	-1.130	-0.799
	(8.075)	(6.145)	(1.990)	(2.220)
Monetary policy	0.042	0.053	0.119*	0.155**
(γ_1)	(0.073)	(0.066)	(0.066)	(0.061)
Output gap				
Agriculture (γ_{21})	-0.039	0.033	0.007	0.019
	(0.071)	(0.052)	(0.055)	(0.061)
Manufacturing (γ_{22})	0.009*	0.005	0.008	0.035
	(0.005)	(0.005)	(0.071)	(0.068)
Services (γ_{23})	-0.007***	-0.005***	-0.031	0.000
	(0.002)	(0.001)	(0.109)	(0.118)
Productivity growth				
Agriculture (γ_{31})	-5.338*	-6.976***	-0.021	-0.017
	(2.643)	(1.886)	(0.034)	(0.038)
Manufacturing(γ_{32})	1.891	-2.076	-0.044	-0.037
	(5.375)	(4.756)	(0.029)	(0.032)
Services(γ_{33})	1.467	5.307	0.037	0.058
	(3.659)	(5.548)	(0.040)	(0.035)

Table 5: continues

CPI items	Convergence of CPI		Co-movement of CPI	
	Tradable vs Non-tradable	Goods vs Services	Tradable vs Non-tradable	Goods vs Services
Bilateral value added trade				
Agriculture	2.623	5.071*	-0.303	-0.074
$(\alpha^i{}_{va\_agr} = \alpha_{11} + \alpha_{21})$	{0.740}	{4.350}	{0.180}	{0.010}
Manufacturing	-3.025**	-2.724**	-0.100	-0.101
$(\alpha^i{}_{va\_man} = \alpha_{12} + \alpha_{22})$	{14.870}	{7.730}	{0.130}	{0.140}
Services	11.629	6.254	-0.092	-0.564
$(\alpha^i{}_{va\_ser} = \alpha_{13} + \alpha_{23})$	{2.560}	{0.470}	{0.000}	{0.100}
Monetary policy	-0.070	-0.085	0.241	0.171
$(\gamma^i{}_{mon} = \gamma_1 + \gamma_4)$	{0.700}	(0.919)	{2.450}	{1.410}
Output gap				
Agriculture	-0.070***	0.075	0.208***	0.155**
$(\gamma^i{}_{gap\_agr} = \gamma_{21} + \gamma_{51})$	{0.700}	{0.490}	{9.240}	{6.580}
Manufacturing	0.176	-0.002	-0.071	-0.091
$(\gamma^i{}_{gap\_man} = \gamma_{22} + \gamma_{52})$	{15.930}	{0.080}	{0.470}	{0.960}
Services	-0.009	-0.005	0.125	0.049
$(\gamma^i{}_{gap\_ser} = \gamma_{23} + \gamma_{53})$	{1.600}	{1.330}	{0.500}	{0.090}
Productivity growth				
Agriculture	-8.881***	-6.588*	0.012	0.001
$(\gamma^i{}_{prd\_agr} = \gamma_{31} + \gamma_{61})$	{20.390}	{3.570}	{0.160}	{0.000}
Manufacturing	-4.562***	0.992	0.138***	0.096*
$(\gamma^i{}_{prd\_man} = \gamma_{32} + \gamma_{62})$	{9.260}	{0.050}	{81.680}	{4.600}
Services	-4.687	-10.063	-0.004	-0.026
$(\gamma^i{}_{prd\_ser} = \gamma_{33} + \gamma_{63})$	{0.280}	{2.960}	{0.010}	{0.370}
N	2736	2736	2352	2352
Adjusted R2	0.384	0.384	0.117	0.112

*, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively. Standard errors are in parenthesis, while F-statistics are in curly brackets. Tradable items: 01. Food and non-alcoholic beverages, 03. Clothing and footwear, 05. Furnishing, household equipment and routine household maintenance, 07. Transportation, 09. Recreation; Goods items: 01. Food and non-alcoholic beverages, 03. Clothing and footwear, 05. Furnishing, household equipment and routine household maintenance, 09. Recreation.

For the estimation of equation 3, in the first specification dummy variable takes values of 1 if items are tradable type; in the second specification it takes values of 1 if items are classified as goods. The results are reported in Table 5. Upper part of the table reports the results for either non-tradable or services items, while bottom part show the coefficient estimates for either tradable or goods items.

Starting with the convergence of CPI analysis, first two columns of Table 5, shows that, although the difference is not statistically significant, value added trade in manufacturing has higher impact on tradable items. Convergence of monetary policy has no significant impact at all. There are evidence on the significant opposing impacts from the convergence in output gap on the convergence of inflation in both tradable, non-tradable and services items, except goods items. There is a negative significant relationship between convergence in productivity growth in agriculture and convergence of inflation in all types of items, but productivity growth convergence in manufacturing has significant opposing impact on tradable items inflation convergence, in particular.

Turning to the co-movement of CPI analysis, additional conclusions can be driven from Table 5. First, although results in Table 4 suggest significance of monetary policy correlation on the overall inflation correlation, Table 5 shows that it is effective only on non-tradable and services items which is mainly composed of non-tradable goods. Inflation in tradable and goods items are correlated to those in partners through co-movement in output gap in agriculture and productivity growth in manufacturing.

4. Conclusion

Input-output linkages have led to a complex flow of value added across countries. Consequently, integration helps reducing inflation gap across countries by efficiently reallocating production to low-cost countries, while making domestic economies more vulnerable to the external shocks, leading co-movement of inflation. This paper explores the role bilateral trade in value added, as an indicator for international production integration, plays in convergence as well as co-movement of 2-digit level CPI inflation between Turkey and trade partners, while simultaneously experiencing real and nominal integrations. It also investigate if convergence and correlation responses of inflation in tradable (goods) differs from those in non-tradable (services).

Findings of this study are consistent with those reported in Auer and Mehrotra (2014) for Asia-Pacific region and Baldwin and López-González (2013) for Asia. They show that real integration through the supply chain matters for domestic price dynamics in emerging countries of the Asia-Pacific region. However, present analysis has deepen our understanding of the linkage of real and nominal integration with the domestic price dynamics for the emerging countries. These results are concern for policymakers.

To sum, our results suggest that correlated monetary policies lead inflation rates to move together, while having no significant effect on convergence. The convergence of inflation, on the other hand, is significantly related with the real integration. There is evidence that value-added trade in manufacturing, (de)convergence in output gap (especially in services) and(de) (de)convergence in productivity growth (particularly in agriculture) play important roles in inflationary (de)convergence process. These facts does not change with respect to the product types. Product type analysis further shows that inflation in tradable items converge at a higher rate and become more correlated with the convergence and co-movement of real variables.

References

Acemoglu, D., Gancia, G. and Zilibotti, F., 2012. Offshoring and directed technical change. NBER Working Paper 18595.

Altansukh, G., Becker, R., Bratsiotis, G. Osborn, D. R., 2017. What is the globalization of inflation? Journal of Economic Dynamics and Control 74, 1-27.

Amador, J., Cabral, S., 2009. Vertical specialization across the world: A relative measure. The North American Journal of Economics and Finance 20(3), 267-280.

Auer, R. A., Borio, C., Filardo, A., 2017. The globalization of inflation: the growing importance of global value chains. BIS Working paper 602.

Auer, R. A., Levchenko, A. A., Saure, P., 2017. International inflation spillovers through input linkages. NBER Working paper 23246.

Auer, R. A., Mehrotra, A., 2014. Trade linkage and the globalization of inflation in Asia and the Pacific. Journal of International Money and Finance 49, 129-151.

Baldwin, R., Lopez-Gonzalez, J., 2013. Supply-chain trade: A portrait of global patterns and several testable hypotheses. CEPR discussion papers no: 9421.

Baldwin, R., Robert-Nicoud, F., 2014. Trade-in-goods and trade-in-tasks: An integrating framework. Journal of International Economics 22(1), 51–62.

Bowdler, C., Malik, A., 2017. Openness and inflation volatility: Panel data evidence. North American Journal of Economics and Finance 41, 57-69.

Brož, V., Kočenda, E. 2018. Dynamics and factors of inflation convergence in the European Union. Journal of International Money and Finance 86, 93-111.

Ciccarelli, M., Mojon, B., 2010. Global inflation. Review of Economics and Statistics 92(3): 524–535.

Daudin, G., Riffart, C., Schweisguth, D. 2011. Who produces for whom in the world economy? Canadian Journal of Economics 44(4), 1403-1437.

Dixon, H., Griffiths, D., Lawson, L., 2004. Exploring tradable and non-tradable inflation in consumer prices, New Zealand Discussion Paper.

Egger, H., Egger, P., 2002. How international outsourcing drives up Eastern European wage. Weltwirtschaftliches Archiv, 138(1), 83–96.

Egger, P., 2006. Intermediate goods trade and international wage convergence in Central Europe. Empirica, 33, 181–192.

Egger, P., Pfaffermayr, M., 2004. Two dimensions of convergence: National and international wage adjustment effects of cross-border outsourcing in Europe. Review of International Economics 12(5), 833–843.

Eichmeier, S., Pijenburg, K., 2013. The global dimension of inflation – evidence from factor-augmented Phillips curves. Oxford Bulletin of Economics and Statistics 75(1), 103–122.

Feenstra, R. C., Hanson, G. H., 2003. Global production sharing and rising inequality: A survey of trade and wages. In E. K. Choi, & J. Harrigan (Eds.), Handbook of international trade. Oxford, UK: Blackwell Publishing Ltd. http://dx.doi.org/10.1002/9780470756461.ch6.

Feenstra, R.C., Hanson, G.H., 1996. Globalization, outsourcing, and wage inequality. American Economic Review 86(2), 240-250.

Förster, M., Tillmann, P., 2014. Reconsidering the international co-movement of inflation. Open Economic Review 25(5), 841–863.

Geishecker, I., Görg, H., 2008. Winners and losers: A micro-level analysis of international outsourcing and wages. The Canadian Journal Economics 41(1), 243–270.

Grossman, G. and Rossi-Hansberg, E., 2008. Trading tasks: a simple theory of offshoring. American Economic Review 98 (5), 1978–1997.

Ha, J., Kose, M. A., Ohnsorge, F. L., 2019. Global Inflation Synchronization. World Bank Policy Research Working Paper 8768.

Hummels, D., Ishii, J., Yi, K.-M., 2001. The nature and growth of vertical specialization in world trade. Journal of International Economics. 54, 75-96.

Johnson, Noah, 2017. Tradable and non-tradable inflation indexes: replicating New Zealand's tradable indexes with BLS CPI data. Monthly Labor Review (14), May. U.S. Bureau of Labor Statistics. https://doi.org/10.21916/mlr.2017.14

Johnson, R., Noguera, G., 2012. Accounting for intermediates: production sharing and trade in value added. Journal of International Economics 86(2), 224-236.

Jones, R.W. and Kierzkowski, H., 1990. The role of services in production and international trade: a theoretical framework. In: Jones, R. and Kruger, A. (Eds.). The Political Economy of International Trade. Basil Blackwell, Oxford.

Koopman, R., Powers, W., Wang, Z., Wei, S.-J., 2010. Give credit where credit is due: tracing value added in global production chains. NBER Working Paper 16426.

Mumtaz, H., Simonelli, S., Surico, P., 2011. International co-movement, business cycle and inflation: A historic perspective. Review of Economic Dynamics 14, 176-198.

Mumtaz, H., Surico,P., 2012. Evolving international inflation dynamics: world and country-specific factors. Journal of European Economic Association 10(4), 716–734.

Neely, C.J., Rapach, D.E., 2011. International co-movements in inflation rates and country characteristics. Journal of International Money and Finance 30(7), 1471–1490.

Pomfret, R., Sourdin, P., 2018. Value chain in Europe and Asia: Which countries participate? International Economics 153: 34-41.

Saygılı, H., 2017. Production fragmentation and factor price convergence, International Review of Economics and Finance 51, 535-544.

Saygılı, H., 2019. Sectoral inflationary dynamics: cross-country evidence on the open-economy New Keynesian Phillips Curve. Review of World Economics, forthcoming. https://doi.org/10.1007/s10290-019-00340-7

Appendix

Table A1: Estimated results for inflation convergence
Measure of convergence: Coefficient of Variation

Model	1	2	3	4	5	6
Bilateral value added trade						
Total (α_1)	9.810	10.240	9.990	9.977		
	(9.841)	(10.792)	(10.597)	(10.821)		
Agriculture (α_{11})					-0.673	-0.373
					(0.998)	(0.741)
Manufacturing (α_{12})					3.027	2.942
					(3.763)	(3.624)
Services (α_{13})					6.881	2.359
					(7.093)	(4.145)
Monetary policy (de)convergence (γ_1)		-0.534	-0.508	-0.549	-0.645	-0.826
		(1.190)	(1.170)	(1.250)	(1.345)	(1.491)
Output gap (de)convergence						
Total (γ_2)			-0.001	-0.001	-0.001	
			(0.001)	(0.001)	(0.001)	
Agriculture (γ_{21})						0.006
						(0.004)
Manufacturing (γ_{22})						0.003
						(0.002)
Services (γ_{23})						-0.774
						(0.578)
Productivity growth (de)convergence						
Total (γ_3)				0.006	0.006	
				(0.004)	(0.005)	
Agriculture (γ_{31})						0.001
						(0.001)
Manufacturing(γ_{32})						0.000
						(0.000)
Services(γ_{33})						0.002
						(0.001)
N	2,916	2,916	2,916	2,808	2808	2,784
Adjuster R2	0.020	0.020	0.020	0.020	0.020	0.022

*, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively. Standard errors are in parenthesis.

Central Bank of the Republic of Turkey

Recent Working Papers

The complete list of Working Paper series can be found at Bank's website

(**http://www.tcmb.gov.tr**)

Macroprudential Policies, Credit Guarantee Schemes and Commercial Loans: Lending Decisions of Banks
(Selva Bahar Baziki, Tanju Çapacıoğlu Working Paper No. 21/20, August 2021)

Declining Labor Market Informality in Turkey: Unregistered Employment and Wage Underreporting
(Yusuf Kenan Bağır, Müşerref Küçükbayrak, Huzeyfe Torun Working Paper No. 21/19, August 2021)

Assessing the Effects of Covid-19 Containment Measures on Manufacturing and Services Industries
(Cem Ali Gökçen Working Paper No. 21/18, August 2021)

Tradable and Non-tradable Inflation in Turkey: Predicting Different States with Markov Regime-Switching Approach
(Hülya Saygılı, Aysun Türkvatan Working Paper No. 21/17, July 2021)

Determinants of ICO Success and Post-ICO Performance
(Aylin Aslan, Ahmet Şensoy, Levent Akdeniz Working Paper No. 21/16, July 2021)

Heterogeneous Effect of Exchange Rates on Firms' Exports: Role of Labor Intensity
(Kurmaş Akdoğan, Yusuf Kenan Bağır, Huzeyfe Torun Working Paper No. 21/15, July 2021)

Constructing an Economic Activity Indicator for Turkey
(Aysu Çelgin, Elif Akbostancı Working Paper No. 21/14, July 2021)

Tariff Changes by Turkey During the Covid-19 Pandemic: Impact on Import Value and Import Prices
(Yusuf Kenan Bağır Working Paper No. 21/13 July 2021)

Does Stock Market Listing Boost or Impede Corporate Investment?
(İbrahim Yarba, Ahmet Duhan Yassa Working Paper No. 21/12, July 2021)

Nowcasting and Short-term Forecasting Turkish GDP: Factor-MIDAS Approach
(Selçuk Gül, Abdullah Kazdal Working Paper No. 21/11, July 2021)

Firm-Level Impact of Credit Guarantees: Evidence from Turkish Credit Guarantee Fund
(Ufuk Akçiğit, Ünal Seven, İbrahim Yarba, Fatih Yılmaz Working Paper No. 21/10, April 2021)

The Importance of External Shocks and Global Monetary Conditions for A Small-Open Economy
(Gülnihal Tüzün Working Paper No. 21/09, April 2021)

Okun's Law under the Demographic Dynamics of the Turkish Labor Market
(Evren Erdoğan Coşar, Ayşe Arzu Yavuz Working Paper No. 21/08, March 2021)

Potential Growth in Turkey: Sources and Trends
(Orhun Sevinç, Ufuk Demiroğlu, Emre Çakır, E. Meltem Baştan Working Paper No. 21/07, March 2021)

Cost of Credit and House Prices
(Yusuf Emre Akgündüz, H. Özlem Dursun-de Neef, Yavuz Selim Hacıhasanoğlu, Fatih Yılmaz Working Paper No. 21/06, March 2021)

External Vulnerabilities and Exchange Rate Pass-Through: The Case of Emerging Markets
(Abdullah Kazdal, Muhammed Hasan Yılmaz Working Paper No. 21/05, February 2021)