Does domestic output gap matter for inflation in a small open economy?

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Motivation

- The weakening of relationship between inflation and domestic output gap in many economies during last two decades:
  - globalization process (Borio and Filardo, 2007, Chmielewski and Kot, 2006)
  - in 90-ies and in the beginning of 2000-ies stable and low inflation due to higher credibility of central banks (Blanchard and Gali, 2007, Evans and Fisher, 2011)
  - in the second half of 2000-ies heightened inflation due to long lasting positive shocks to food and fuel prices
  - counter-cyclical impact of increase in taxes and regulated prices
- This weakening may be more pronounced for small open economies, which are more sensitive to external shocks and to global output gap
- The core inflation measures are usually weakly correlated with the domestic output gap (Chmielewski and Kot, 2006)
- We search for components of the inflation index which are sensitive to domestic demand

Method

- Disaggregated analysis using price indices at the COICOP 4-digit level
- We check which groups of goods and services constituting CPI in Poland react to changes in domestic economic activity measured as an output gap
- We analyse the sensitivity of disagregated price groups of goods and services to the exchange rate channel

Literature

- Phillips curve for aggregated data - a lot of research
  - in DSGE models - i.e. Del Negro et al. (2007),
  - univariate model - i.e. Razzak (2002), Rumler and Valderrama (2010)
  - small open economies - Guender and Xie (2006)
- The sensitivity analysis of disagregated price indices in respect to the output gap:
  - Bryan, Meyer (2010) - differentiated between sticky and flexible prices which are more sensitive to changes in economic activity in the US
  - Fröhling, Lommatzsch (2011) - dissagregated Phillips curves for euro area as a whole and for member countries
    - backward looking
    - only lagged inflation (y/y) and economy-wide output gap

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Small open economy Phillips curve

- Gali and Monacelli (2005) proposed a NK Phillips curve basing on a small open economy version of the Calvo sticky price model
- For the empirical analysis hybrid NKPC extensively used - relates current inflation to both future and past inflation
- Aggregated small open economy hybrid NKPC for Poland:
  - Kłos et al. (2005), Przystupa and Wróbel (2009) - analysis of monetary policy transmission mechanism,
  - Baranowski and Leszczyńska (2011) - forecasting performance in respect to the inflation.

Phillips curve for disaggregated data

- From a theoretical point of view disaggregated price indices should be related to disaggregated (sectoral) output gaps, but:
  - the structure of the CPI basket specified on the basis of households' budgets survey
  - the prices in the CPI calculated using the individual quotations of particular services and goods in retail trade
  - while output gap usually measured using GDP, industrial production or some labour market variables
- Output gap measures do not match with the structure and methodology of CPI basket - problem with sectoral output gaps for CPI categories

Phillips curve for disaggregated data

- Sectoral output gaps approximated by economy-wide output gap
- Backward looking version of the Phillips curve which matches data better than forward looking and hybrid PC:

$$\pi_{i,t} = \alpha_0 + \sum_{p=1}^{P} \alpha_p \pi_{i,t-p} + \beta \bar{y}_{t-1} + \gamma er_{t-1} + \delta control_t + \varepsilon_{i,t}$$

where

$\pi_{i,t}$ - a quarterly inflation in i-th category of goods and services,

$\bar{y}_t$ - an economy-wide output gap,

er_t - a quasi-real exchange rate (a sum of an effective nominal exchange rate and foreign inflation),

$control_t$ - the variables (only for food and fuel categories) express the relative growth of food or fuel prices to foreign inflation

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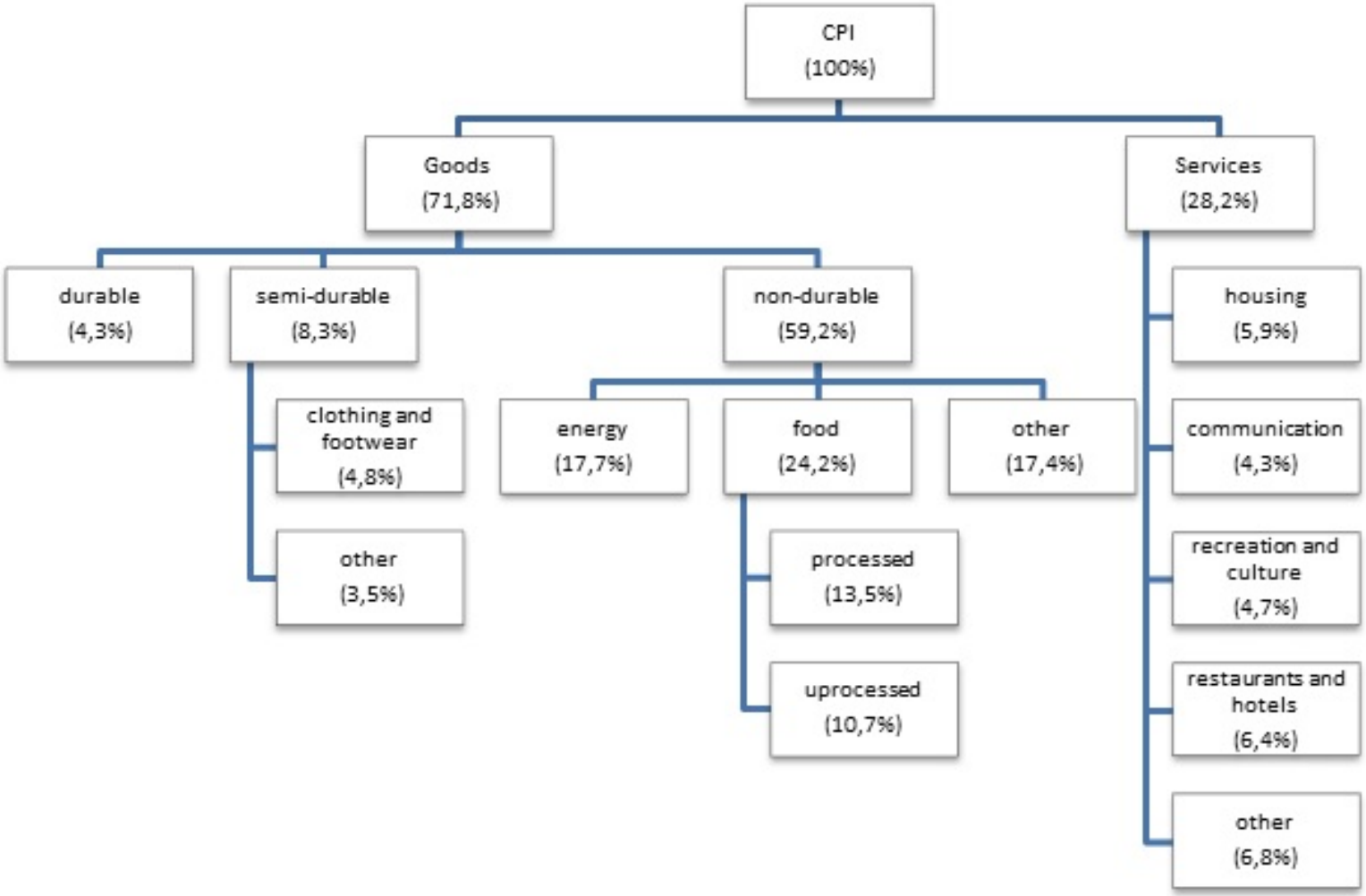
Data

- Consumer Price Index (CPI) disaggregated to COICOP 4-digit level
- Output gap - two alternative measures:
  - based on the production function from the National Bank of Poland structural macroeconometric model (NECMOD) - see Budnik et al. (2009)
  - derived using HP filter
- Exchange rate: Nominal effective exchange rate plus foreign inflation (EA + US)
- Control variables: relative growth of food and fuel prices to foreign inflation
- Seasonally adjusted quarterly data
- Sample: 1999Q1-2012Q2

CPI structure in Poland



Source: Own calculations, Polish Central Statistical Office data.

Estimation of disaggregated Phillips curves

- Phillips curve

$$\pi_{i,t} = \alpha_0 + \sum_{p=1}^{P} \alpha_p \pi_{i,t-p} + \beta \bar{y}_{t-1} + \gamma er_{t-1} + \delta control_t + \varepsilon_{i,t}$$

- Estimation of 220 models (110 indices times two alternative measures of an output gap)
- Individual Phillips curves estimated (equation by equation) with the OLS using Newey-West correction
- The categories of goods and services classified as price sensitive to domestic output gap if the output gap statistically significant at 10% significance level
- Two lags of inflation and one lag of an output gap and exchange rate
- The results are quite robust in respect to the choice of output gap measure

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Goods and services sensitive to the output gap

		NECMOD gap		HP gap	
	weight	weight		weight	
	in CPI	in category	in CPI	in category	in CPI
All	100.0	55.3	55.3	56.5	56.5
services	28.2	55.1	15.5	62.9	17.7
durable	4.3	35.7	1.5	35.7	1.5
semi-durable	8.3	28.5	2.4	28.5	2.4
non-durable	59.2	60.5	35.8	58.9	34.9
administered	14.0	55.8	7.8	77.3	10.8

Source: Own calculations.

Services sensitive to the output gap

	weight in category	weight in CPI
Sensitive		
Restaurants	20.6	5.8
Housing	13.0 (21.0)	3.7 (5.9)
Health	5.6	1.6
Tourism	5.1	1,4
Personal care	1.3	0,4
Hotels	1.2	0,3
Recreation	1.0	0,3
Non-sensitive		
Communication	15.0	4.2
Transport	4.1	1.2
Insurance	3.4	1.0
Education	1.9	0.5

Source: Own calculations.

Non-durable goods sensitive to the output gap

		NECMOD gap		HP gap	
	weight in CPI	weight		weight	
		in category	in CPI	in category	in CPI
Unprocessed food	13.5	54.1	7.3	59.2	8.0
Processed food	10.7	66.5	7.1	66.5	7.1
Energy	17.7	56.4	10.0	56.4	10.0

Source: Own calculations.

Semi-durable goods sensitive to the output gap

	weight in category	weight in CPI
Sensitive	**28.5**	**2.4**
Household textiles and equipment	10.5	1.0
Non-sensitive	**71.5**	**5.9**
Clothing and footwear	58.2	4,8
Recreation and culture	11.8	1.0
from which:		
Games, toys and hobbies	4.5	0.4
Books	6.5	0.5
Small electric household appliances	1.2	0.1

Source: Own calculations.

Durable goods sensitive to the output gap

	weight in category	weight in CPI
Sensitive	**35.7**	**1.5**
Furnitures and furnishings	29.8	1.3
Non-sensitive	**64.3**	**2.8**
Purchase of vechicles	35.4	1,5
Audio visual appliances	15.9	0.7
Household appliances	11.6	0.5

Source: Own calculations.

Goods and services sensitive to the exchange rate channel

		NECMOD gap		HP gap	
	weight	weight		weight	
	in CP	in category	in CPI	in category	in CPI
services	28.2	29.4	8.3	29.4	8.3
durable	4.3	66.5	2.9	66.6	2.9
semi-durable	8.3	35.0	2.9	35.0	2.9
non-durable	59.2	33.3	19.7	30.7	18.2
administered	14.0	0.0	0.0	0.0	0.0
globalisation	8.6	12.4	1.1	12.5	1.1

Source: Own calculations. Category "globalization" comprises the goods usually decribed as beeing influenced by globalization.

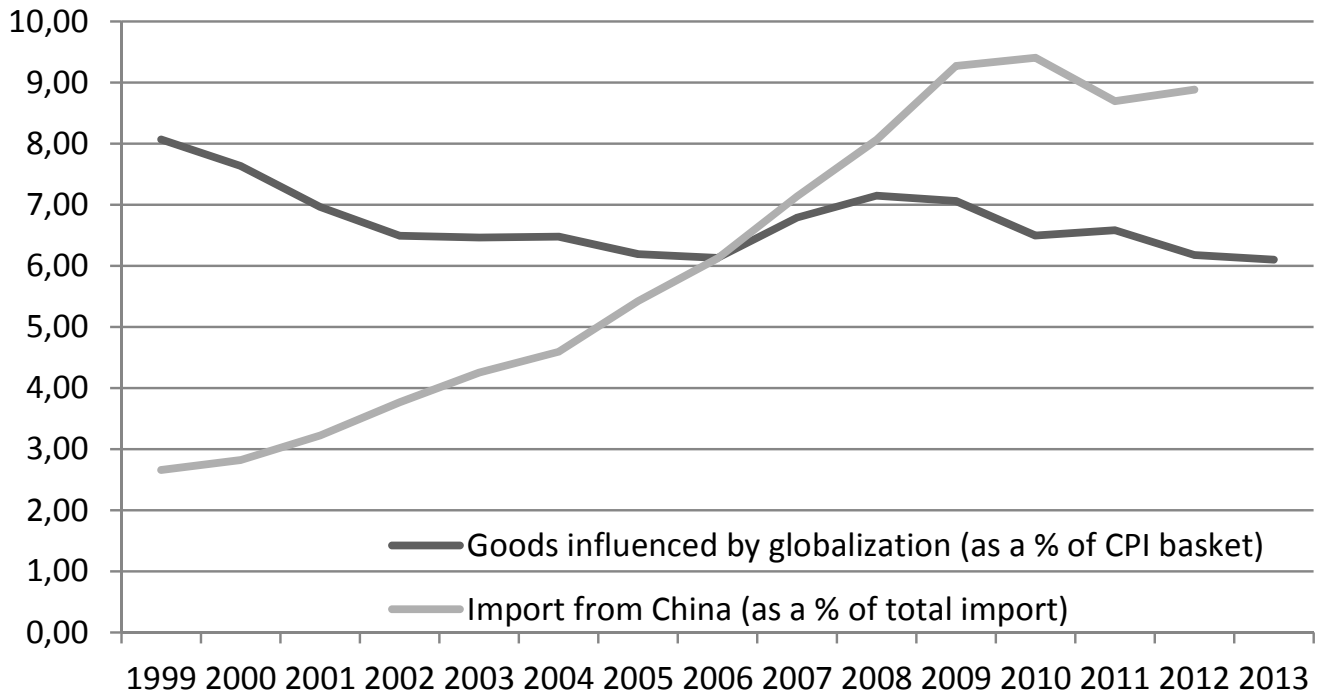
Goods influenced by globalization

- The goods influenced by globalization:
  - clothes and footwear, games and toys, audio visual equipment, electrical appliances for personal care, equipment for sport and recreation
- They constitute 8.8% of the CPI basket

	weight in category	weight in CPI
Sensitive to the output gap	30.0	2.6
Sensitive to the exchange rate	12.4	1.1

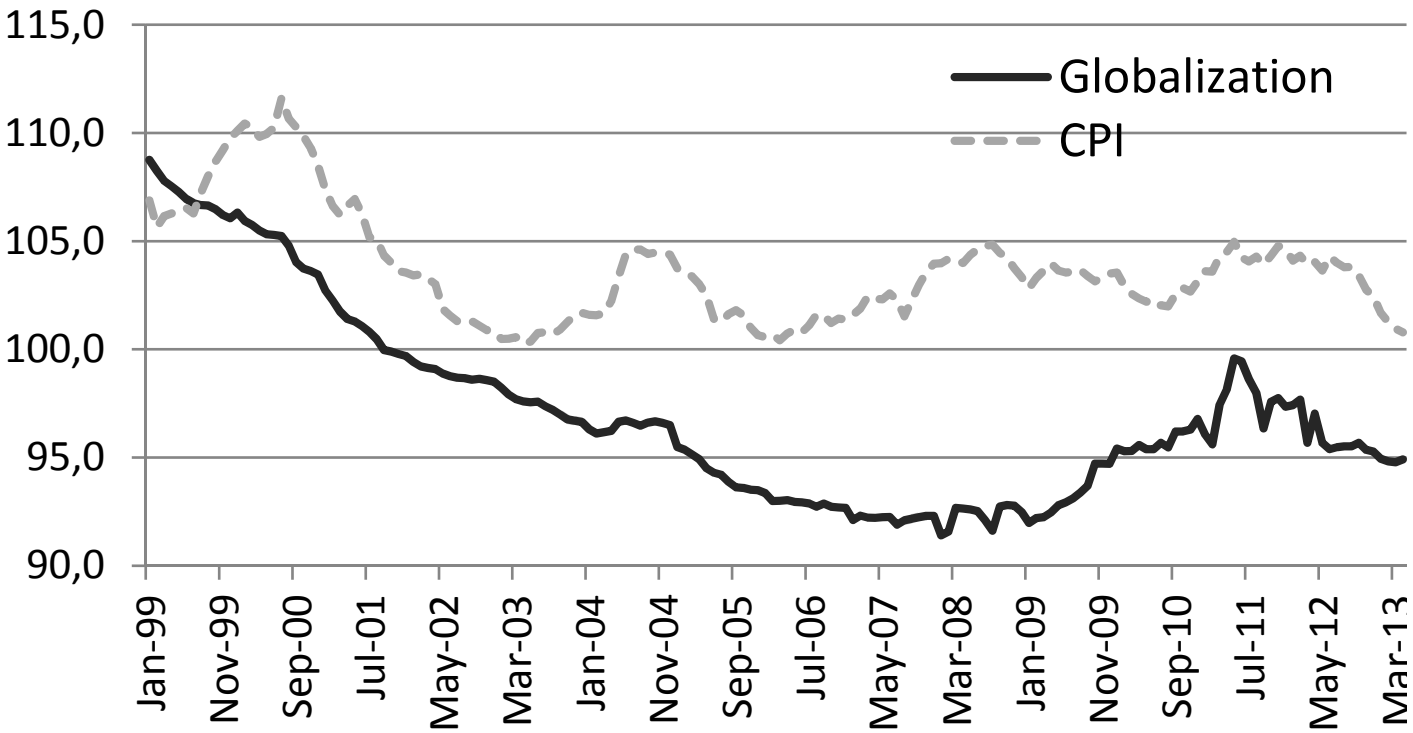
Source: Own calculations.

Goods influenced by globalization



Source: Own calculations, NBP and Polish Central Statistical Office data.

Goods influenced by globalization



Source: Own calculations, NBP and Polish Central Statistical Office data.

Index of demand sensitive goods (IDSG)

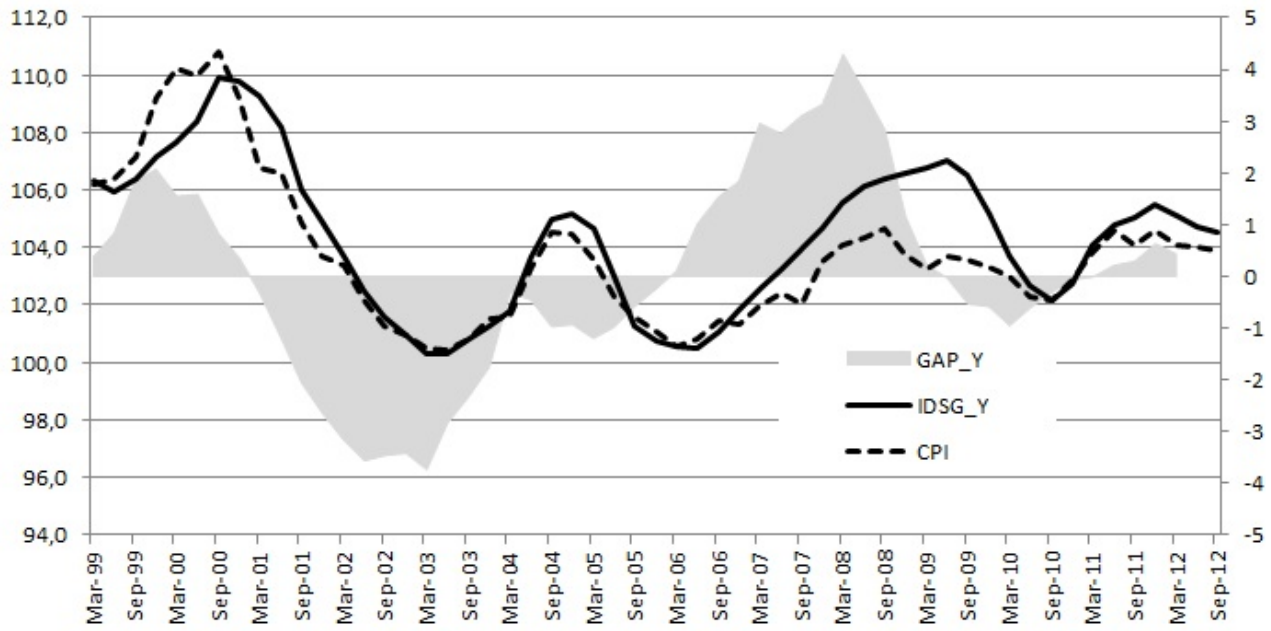
We aggregate the price indices of goods and services sensitive to the output gap

- The new index: the index of goods and services sensitive to output gap (IDSG - index of demand sensitive goods)
- Includes the price categories which have been statistically significant at 10% level
- The weights are assigned according to weights in the CPI basket

IDSG - features

- Measure of inflationary pressure in the economy stemming from excessive domestic demand
- IDSG has some advantages over the output gap:
  - IDSG allows quantifying the excessive demand pressure in terms of price development. The index can be directly compared with the CPI and core inflation measures
  - Calculated on a monthly basis which reduces the lag substantially
- While the IDSG covers almost all goods sensitive to exchange rate, the monitoring of the index may give an additional information to the central bank when conducting the monetary policy and address the question to what extent the inflation is beeing influenced by the domestic monetary policy (interest rate channel and exchange rate channel)

IDSG vs CPI



Source: Own calculations, NBP and Polish Central Statistical Office data.

Descriptive statistics for selected inflation measures

Index	mean	standard deviation
CPI	3.8	2.5
Inflation excluding administered prices	3.3	2.6
Inflation excluding most volatile prices	2.8	1.4
Inflation excluding food and energy prices	3.1	3.0
15% trimmed mean inflation	3.5	2.2
Inflation of goods influenced by globalization	-2.8	4.5
IDSG_Y	4.4	2,5
IDSG_HP	4.4	2.7

Source: CSO and own calculations.

Rows 3-6 contain statistics for core inflation measures calculated by NBP. In rows 7-8 the respective statistics for two variants of index of output gap sensitive prices are included. IDSG_Y is the index derived using output gap from NECMOD model while IDSG_HP has been calculated with the output gap derived using HP filter

Index of demand sensitive goods vs output gap

- Aggregated Phillips Curve

$$\pi_t = \alpha_0 + \sum_{p=1}^{P} \alpha_p \pi_{t-p} + \beta \bar{y}_{t-1} + \gamma er_{t-1} + \delta control_t + \varepsilon_{i,t}$$

where:
π_t - inflation measure (IDSG, CPI, two core inflation measures)
$\tilde{y}_t$ - domestic output gap
er_t - effective nominal exchange rate plus foreign inflation
$control_t$ - relative food and fuels prices growth abroad

- Estimation by OLS and GMM to check for endogeneity problem

Sensitivity of inflation measures in respect to the output gap

Inflation measure	NECMOD gap		HP gap	
	OLS	GMM	OLS	GMM
IDSG	0.00113 (0.00024)	0.00095 (0.00019)	0.00354 (0.00081)	0.00353 (0.00052)
CPI	0.00070 (0.00028)	0.00060 (0.00018)	0.00163 (0.00056)	0.00119 (0.00043)
CORE	0.00047 (0.00014)	0.00041 (0.00009)	0.00106 (0.00028)	0.00102 (0.00016)
COREADM	0.00070 (0.00038)	0.00062 (0.00019)	0.00161 (0.00065)	0.00136 (0.00051)

Source: Own calculations.

The numbers in the table are estimates and standard errors of parameters expressing the impact of the output gap on inflation for different output gap and inflation measures in aggregated Phillips curve

Abbreviation *CORE* denotes inflation excluding food and energy while *COREADM* is inflation excluding administered prices.

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Findings

1. More than 55 per cent of the categories in the CPI basket react to the output gap.
2. The categories mostly linked to domestic output gap are services but also non-durable goods.
3. Prices of more than half of the items in either unprocessed or processed food as well as energy categories are influenced by changes in domestic demand.
4. Only a small share of durable and semi-durable goods react to domestic output gap - to some extent due to globalization process.
5. One third of the price indices respond to exchange rate channel.
6. The impact of exchange rate is most significant on durable and semi-durable goods which are to a large extent perceived as tradable goods.
7. Only 30 per cent of goods perceived as beeing influenced by globalization react to domestic output gap while 12.5 per cent are sensitive to exchange rate movements.