Under The Tyranny of a Policy

Evaluating the impact of subsidized exchange rate on the evolution of prices and its welfare consequences

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Empirical Microeconomics

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Outline

Overview

- TRUMP exit shocks.
- Exchange rate policy.
- What is the impact of subsidized exchange rate on the evolution of prices and its welfare consequences?
- CPI, HEIS & exchange rate data $\rightarrow$ policy impact on CPI & welfare.
- Empirical Framework: DiD & IV; exchange rate as IV for the interaction term.
- 105% increase in 12 & 52% increase in 6 months.
- Welfare analysis: static representative agent model
- 4 Kg of consumption good drop in social welfare

Institutional Backgrounds

- TRUMP Exit!

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- Jahangiri Dollar $=$ 42000 rials/Dollar.

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- Jahangiri Dollar = 42000 rials/Dollar.
- Essential & Basic Commodities.

Institutional Backgrounds

- TRUMP Exit!
- Exchange rate shock.
- Jahangiri Dollar = 42000 rials/Dollar.
- Essential & Basic Commodities.
- Commodity Inclusion.

Datasets

- Consumer Price Index, Central Bank, 1391/01-1399/11.
- Exchange rates (Market & Nimaee), Central Bank, 1391/01-1399/11.
- Essential & Basic Commodity Lists, 1397-1399, Ministry of Industry, Mine and Trade.
- Iran Household Expenditure & Income Survey, Statistical Centre of Iran, 1396-1397.

Sample

Table 1: Treatment & Control groups.

Treatment	Control
Substitutes	
روغن نباتی	روغن حیوانی
لوبیا قرمز	لوبیا چیتی
گوشت مرغ	کنسرو ماهی
برنج خارجی	برنج ایرانی
گوشت دام	انواع کالباس
انواع کره	انواع پنیر
Irrelevant	
شکر	نمک
روزنامه و مجله	دفتر و دفترچه
چای خارجی	انواع نوشابه
لاستیک ماشین خارجی	لنت ترمز ماشین سواری
دارو	لوازم طبی و درمانی

Motivation

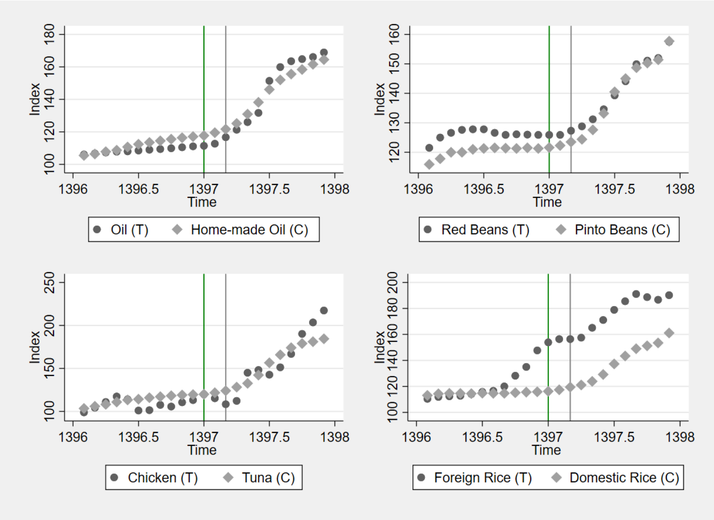


Figure 1: Parallel Trends.

Motivation

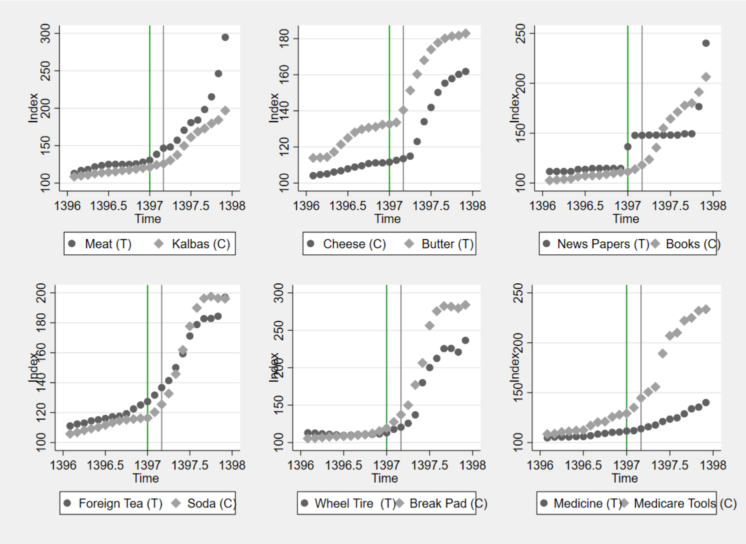


Figure 2: Parallel Trends.

Diff. in Diff.

$$\log(\text{Index}_{it}) = \alpha_i + \gamma_t + \beta D_{it} + \varepsilon_{it} \tag{1}$$

- Index_{it}: Price Index of commodity i in time t.
- α_i: Commodity fixed effect.
- γ_t: Time fixed effect.
- D_{it}: 1 for subsidized commodity i in time t, zero otherwise.
- β: Coefficient of interest.

Pitfalls of DiD

1. Supplement & Substitute Commodities.

Pitfalls of DiD

1. Supplement & Substitute Commodities.
2. Omitted Variables.

Pitfalls of DiD

1. Supplement & Substitute Commodities.
2. Omitted Variables.
3. Imperfect Data.

Instrumented DiD[3]

- Using the difference of market dollar and Nimaee(42000) as IV, for interaction term (D_{it}).
- Relevance & Exogeneity
- Monotonicity: Those which are affected are affected in the same direction.
- Exclusion Restriction: The policy implemented because of volatile exchange rate.
- In case of demands: low elasticity.
- Substitution effect through the policy.
- See Hudson et al. (2017) and de Chaisemartin (2010) for discussion on this method.

[3] More information here.

Intuitions Behind IV

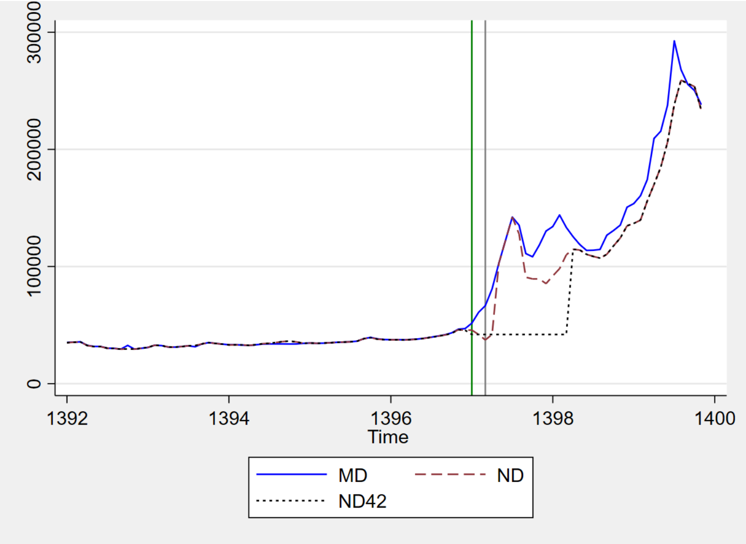


Figure 3: Dollars price in time.

DDIV results I

Table 2: First stage and OLS/2SLS results for all commodities.

	(1) 12 Months First stage	(2) 12 Months OLS	(3) 12 Months 2SLS	(4) 6 Months First stage	(5) 6 Months OLS	(6) 6 Months 2SLS
MN42	0.00000476***			0.00000619***		
	(0.00000116)			(0.00000151)		
D		0.307***	1.053***		0.121***	0.522***
		(0.0429)	(0.249)		(0.0239)	(0.132)
_cons	0.0695***	4.830***	4.661***	0.0958***	4.800***	4.713***
	(0.0169)	(0.0261)	(0.0164)	(0.0233)	(0.0224)	(0.0191)
N	575	575	575	276	276	276
chi2	16.89	51.27	17.88	16.86	25.37	15.65

Standard-errors are robust.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

DDIV results II

Table 3: First stage and OLS/2SLS results for substitute commodities.

	(1) 12 Months First stage	(2) 12 Months OLS	(3) 12 Months 2SLS	(4) 6 Months First stage	(5) 6 Months OLS	(6) 6 Months 2SLS
MN42	0.00000456**			0.00000593**		
	(0.00000163)			(0.00000212)		
D		0.196***	0.937**		0.0700***	0.427*
		(0.0276)	(0.353)		(0.0111)	(0.176)
_cons	0.0666**	4.844***	4.684***	0.0918**	4.808***	4.734***
	(0.0238)	(0.0327)	(0.0186)	(0.0329)	(0.0253)	(0.0203)
N	300	300	300	144	144	144
chi2	7.831	50.21	7.028	7.802	39.85	5.897

Standard-errors are robust.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Snapshot

- We obtain social welfare change upon the policy following Chetty's (2008) guide.
- We model the policy by a subsidy given to the firm that is funded by a tax levied on the household.
- We assess welfare cost of counterfactual policies using our model.

Firm and Household Problems

A representative price-taker firm solves

$$\max_{\{x_n\}_{n=1}^{N-1}} \quad \{p_1 x_1 + \cdots + p_{N-1} x_{N-1} - c(x_1, \ldots, x_{N-1}) + S(x_1)\}$$

A representative household solves

$$\max_{\{x_n\}_{n=1}^{N}} \{u(x_1, \ldots, x_{N-1}) + x_N\}$$

$$\text{s.t.} \quad p_1 x_1 + \cdots + p_{N-1} x_{N-1} + x_N + T(s) = \omega \qquad \text{(BC)}$$

- $\{x_n\}_{n=1}^{N-1}$: The set of consumption goods; x_N: The numeraire
- $c(.)$: Cost of production
- $S(x_1)$: A subsidy for the firm to produce x_1.
- $T(s)$: A tax to finance the subsidy.
- ω: The household endowment.

Firm and Household Problems (Cont.)

Closing the model requires that in the equilibrium:

$$(x_n^*)^{De} = (x_n^*)^{Su} \quad \forall n \in \{1, \ldots, N-1\} \quad \text{(Good market clearance)}$$
$$T(s) = S(x_1^*) \quad \text{(Government budjet constraint)}$$

Social Welfare Formula

Social welfare is

$$W(x_1, \ldots, x_N; T, S) =$$

$$\left[\max_{\{x_n\}_{n=1}^{N-1}} \{p_1 x_1 + \cdots + p_{N-1} x_{N-1} - c(x_1, \ldots, x_{N-1}) + S(x_1)\} \right]$$

$$+ \left[\max_{\{x_n\}_{n=1}^{N}} \{u(x_1, \ldots, x_{N-1}) + x_N + \lambda[\omega - T(s) - p_1 x_1 - \cdots - x_N]\} \right]$$

$$+ [-S(x_1)]$$

Social Welfare Derivative

Assuming $S(x_1) = sx_1$, $T(s) = sx_1$ and by the Envelop Theorem,

$$\frac{\mathrm{d}}{\mathrm{d}s} W(\mathbf{x}; T, S) = \sum_{n=1}^{N} \frac{\partial W}{\partial x_n} \frac{\mathrm{d}x_n}{\mathrm{d}s} + \frac{\partial W}{\partial T} \frac{\mathrm{d}T}{\mathrm{d}s} + \frac{\partial W}{\partial S} \frac{\mathrm{d}S}{\mathrm{d}s}$$
$$= -2\lambda x_1(s) - (1+\lambda)\, s\, x_1'(s)$$

Using the FOC of HH problem wrt x_1 or x_N, $\lambda = 1$ then

$$\frac{\mathrm{d}}{\mathrm{d}s} W(\mathbf{x}; T, S) = -2\left[x_1(s) + sx_1'(s)\right] \tag{2}$$

Derivative of W Calculation of λ

Implementation

Integrating both sides of (2) over $[s_1, s_2]$ yields ▸ Integration

$$W(s_2) - W(s_1) = -2\left[s_2 x_1(s_2) - s_1 x_1(s_1)\right]$$

Suppose $s_1 = 1$, then

$$1 - r = \frac{\text{discretionary exchange rate}}{\text{prevailing exchange rate}} = \frac{4.2}{10.2} \Rightarrow r = 0.6$$

Let $s_2 = s_1 + r = 1 + 0.6 = 1.6$

We Substitute the change in average households' demands of good x_1 for $x_1(s_1)$ and $x_1(s_2)$ (HIES).

Welfare Analysis Results

Table 4: Consumption and welfare change due to the policy

good_name	c_96	c_97	c_change	welfare_cost
Butter	491	497	6	-608.4
Chicken	5850	5685	-165	-6492
Imported rice	11513	11274	-239	-13050.8
Imported tea	590	572	-18	-650.4
Meat	2015	1965	-50	-2258
Red bean	1228	1239	11	-1508.8
Sugar	2440	2358	-82	-2665.6
vegetble oil	5147	4940	-207	-5514

Counterfactual Policy analysis

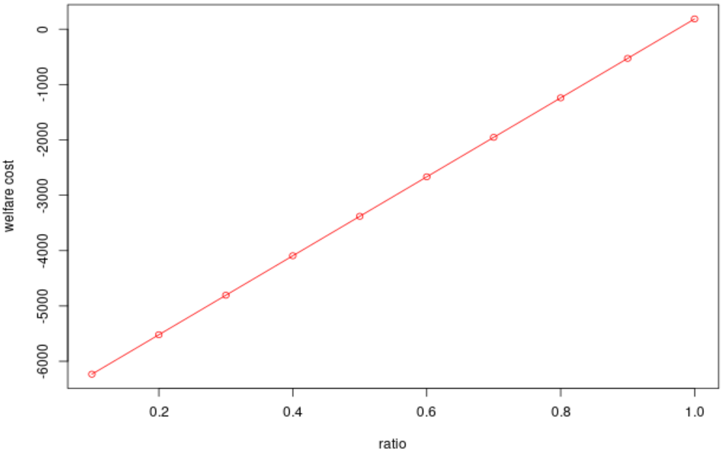


Figure 4: Average welfare cost by $\frac{\text{discretionary}}{\text{market}}$ ratio

Concluding Remarks

Review of results

1. Using IV for the DiD estimator we find 105% and 52% increase in price indexes through the policy in 12 and 6 months respectively.
2. There isn't a large difference between results for different commodity groups.
3. We estimate an average welfare cost of 4 Kg upon the policy.

limitations

1. Our empirical strategy neglects dynamic heterogeneous treatment effect.
2. Our welfare analysis assumes price taker firms and cannot take account of cross-price elasticities.

Thank You

References

Chetty, R. (2008). Sufficient statistics for welfare analysis: A bridge between structural and reduced-form methods.

de Chaisemartin, C. (2010). A note on instrumented difference in differences. *Unpublished Manuscript, University of Warwick*.

Hudson, S., Hull, P., and Liebersohn, J. (2017). Interpreting instrumented difference-in-differences. *Metrics Note, Sept*.

Social Welfare Derivative

$$\frac{\mathrm{d}}{\mathrm{d}s} W(\mathbf{x}; T, S) = \underbrace{\sum_{n=1}^{N} \frac{\partial W}{\partial x_n} \frac{\mathrm{d}x_n}{\mathrm{d}s}}_{A} + \underbrace{\frac{\partial W}{\partial T} \frac{\mathrm{d}T}{\mathrm{d}s}}_{B} + \underbrace{\frac{\partial W}{\partial S} \frac{\mathrm{d}S}{\mathrm{d}s}}_{C}$$

$$= -2\lambda x_1(s) - (1+\lambda)\, s\, x_1'(s)$$

Assuming $S(x_1) = sx_1$ and $T(s) = sx_1$,

- $A = -s\frac{\mathrm{d}x_1}{\mathrm{d}s}$ (Envelope Theorem)
- $B = -\lambda \times (x_1 + s\frac{\mathrm{d}x_1}{\mathrm{d}s})$
- $C = +x_1 + \frac{\mathrm{d}x_1}{\mathrm{d}s} - \lambda x_1 - x_1 - \frac{\mathrm{d}x_1}{\mathrm{d}s}$

Back

Calculating λ

Using FOC of HH problem wrt x_N,

$$\frac{\partial L}{\partial x_N} = \frac{\partial u}{\partial x_N} + \lambda \frac{\partial \mathrm{BC}}{\partial x_N} = 0 \tag{3}$$

$$\Rightarrow 1 + \lambda \times -1 = 0 \tag{4}$$

$$\Rightarrow \lambda = 1$$

or wrt x_1,

$$\frac{\partial L}{\partial x_1} = \frac{\partial u}{\partial x_1} + \lambda \frac{\partial \mathrm{BC}}{\partial x_1} = 0$$

$$\Rightarrow (p_1 + s) + \lambda \times (-p_1 - s) = 0$$

(Quasi-linearity in the numeraire)

$$\Rightarrow \lambda = 1$$

Back

Integration

$$\frac{\mathrm{d}}{\mathrm{d}s} W(\mathbf{x}; T, S) = -2\left[x_1(s) + s x_1'(s)\right]$$

$$\int_{s_1}^{s_2} \mathrm{d}W(s) = -2\left[\int_{s_1}^{s_2} x_1(s)\mathrm{d}s + \underbrace{\int_{s_1}^{s_2} s x_1'(s)\mathrm{d}s}_{I}\right] \tag{5}$$

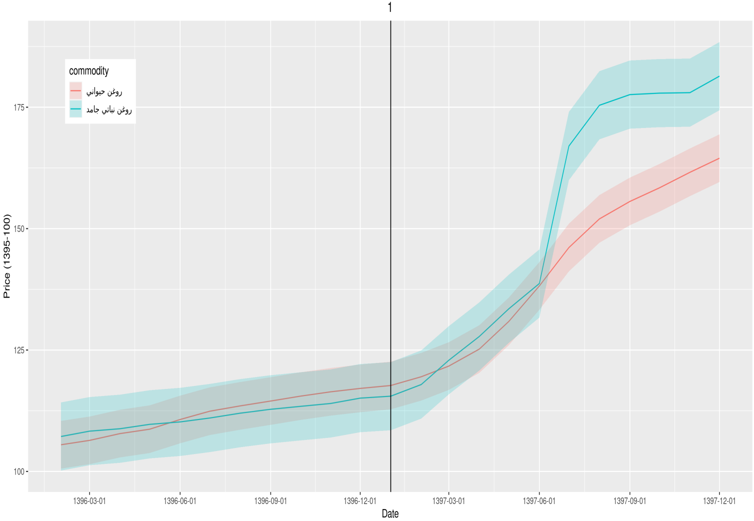
$$I = s x_1(s) - \int_{s_1}^{s_2} x_1(s)\mathrm{d}s \quad \text{(Integration by part)} \tag{6}$$

Substituting (6) into (5) yields:

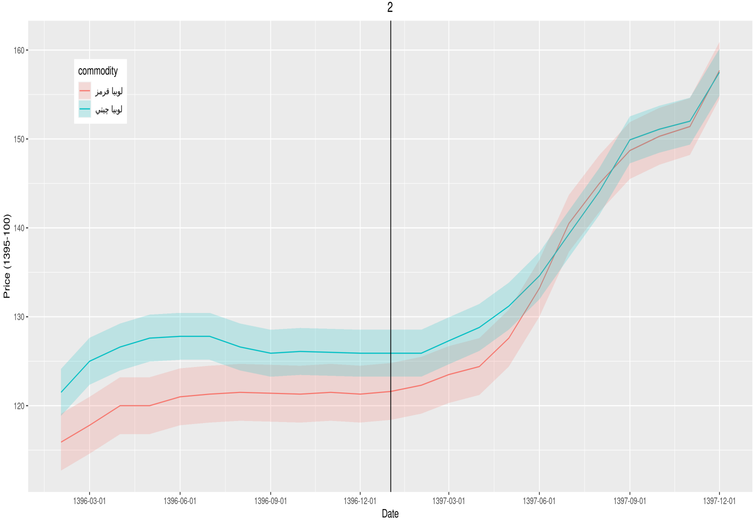
$$W(s_2) - W(s_1) = -2\left[s_2 x_1(s_2) - s_1 x_1(s_1)\right]$$

Back

vegetable Oil

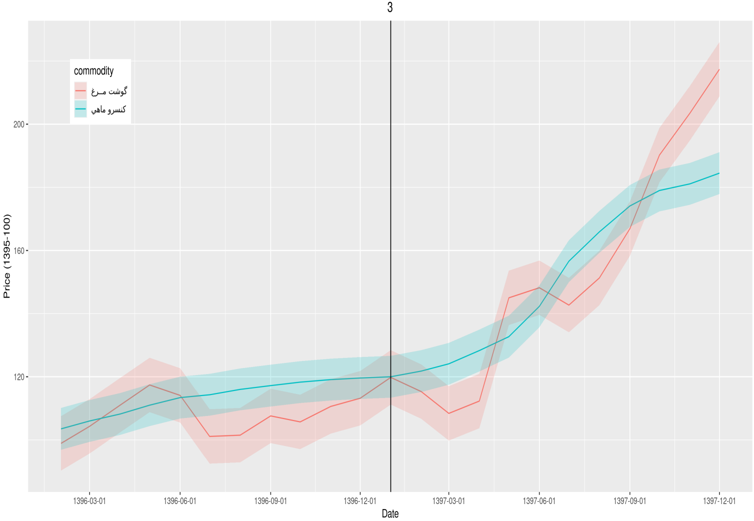


Red Bean



2
commodity
لوبيا قرمز
لوبيا چيتي
Price (1395-100)
160
150
140
130
120
1396-03-01
1396-06-01
1396-09-01
1396-12-01
1397-03-01
1397-06-01
1397-09-01
1397-12-01
Date

Chicken



3
commodity
گوشت مـرغ
كنسرو ماهي
200
160
120
Price (1395-100)
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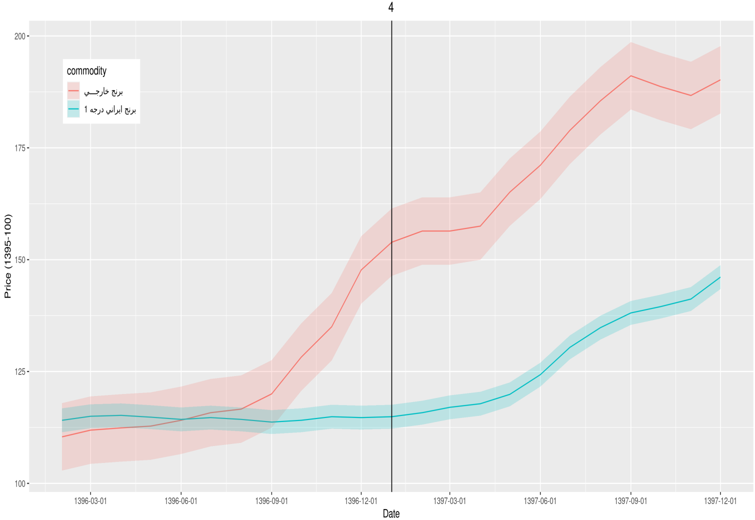
1397-03-01
1397-06-01
1397-09-01
1397-12-01
Date

Rice



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برنج ايراني درجه 1
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175
150
125
100
Price (1395-100)
1396-03-01
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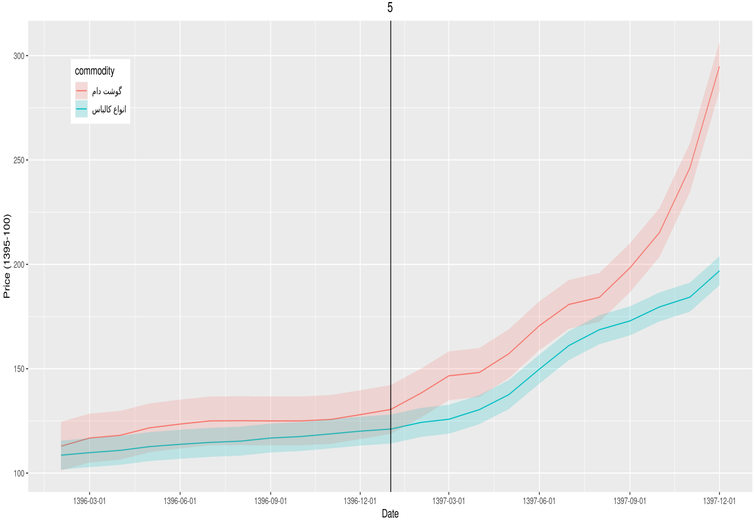
1397-12-01
Date

Meat



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commodity
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انواع کالباس
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1396-06-01
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1396-12-01
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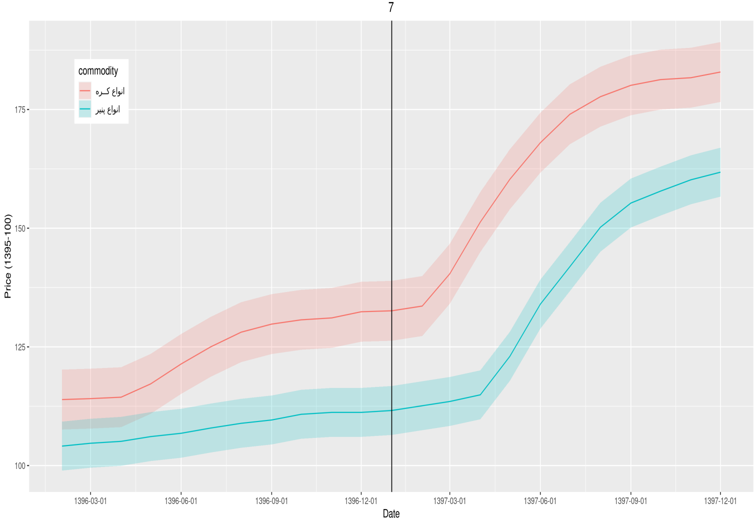
1397-06-01
1397-09-01
1397-12-01
Date

Butter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commodity
انواع کره
انواع پنیر
175
150
125
100
Price (1395-100)
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1396-06-01
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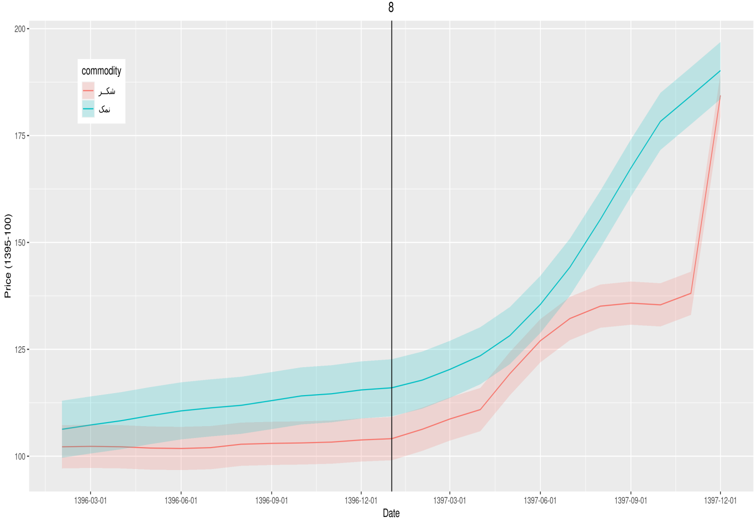
1397-03-01
1397-06-01
1397-09-01
1397-12-01
Date

Sugar



8
commodity
شکـر
نمک
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Price (1395-100)
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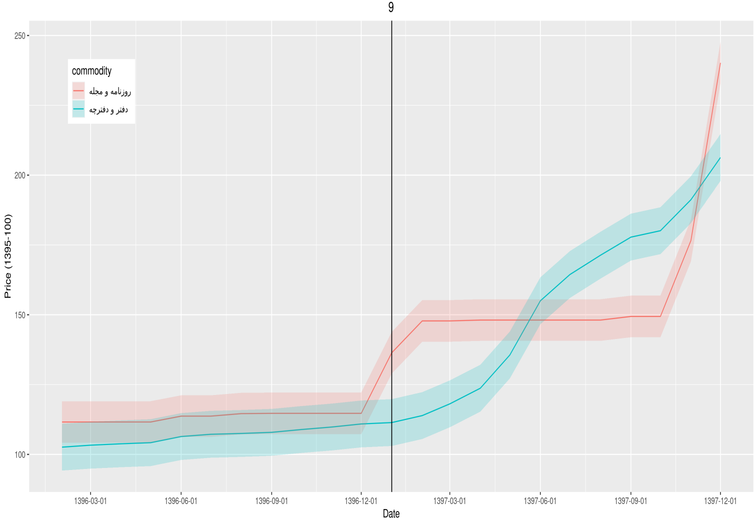
Date

Newspaper



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commodity
روزنامه و مجله
دفتر و دفترچه
Price (1395-100)
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200
150
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1396-06-01
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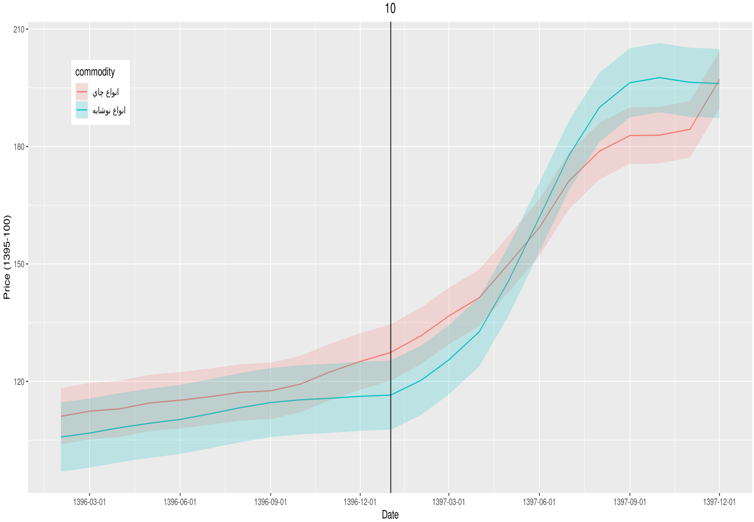
Date

Tea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انواع نوشابه
210
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150
120
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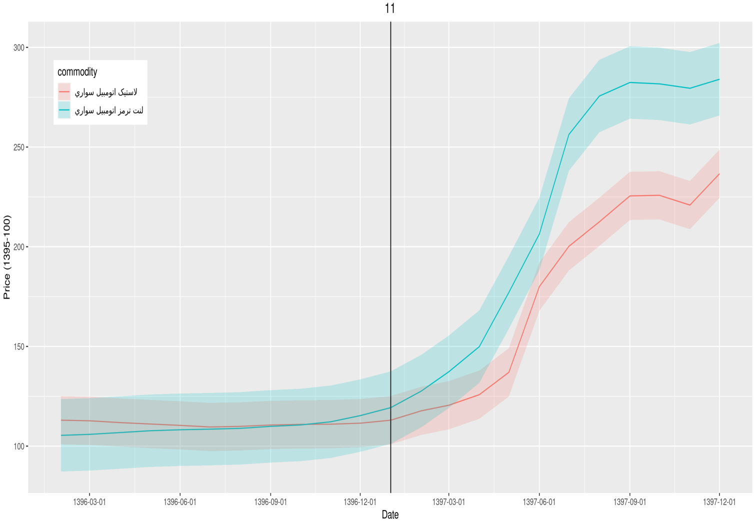
1397-12-01
Date

Brake Pad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لنت ترمز اتومبیل سواري
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1396-06-01
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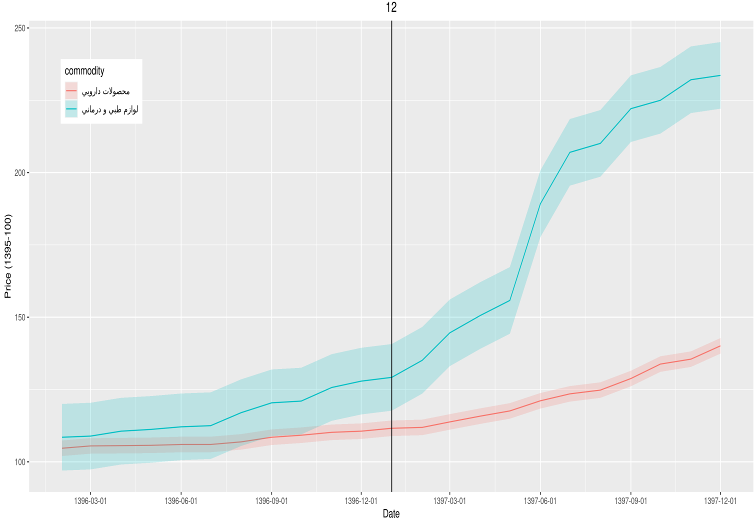
1397-06-01
1397-09-01
1397-12-01
Date

Medicine


12
commodity
محصولات دارويي
لوازم طبي و درماني
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150
100
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1396-06-01
1396-09-01
1396-12-01
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1397-06-01
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