#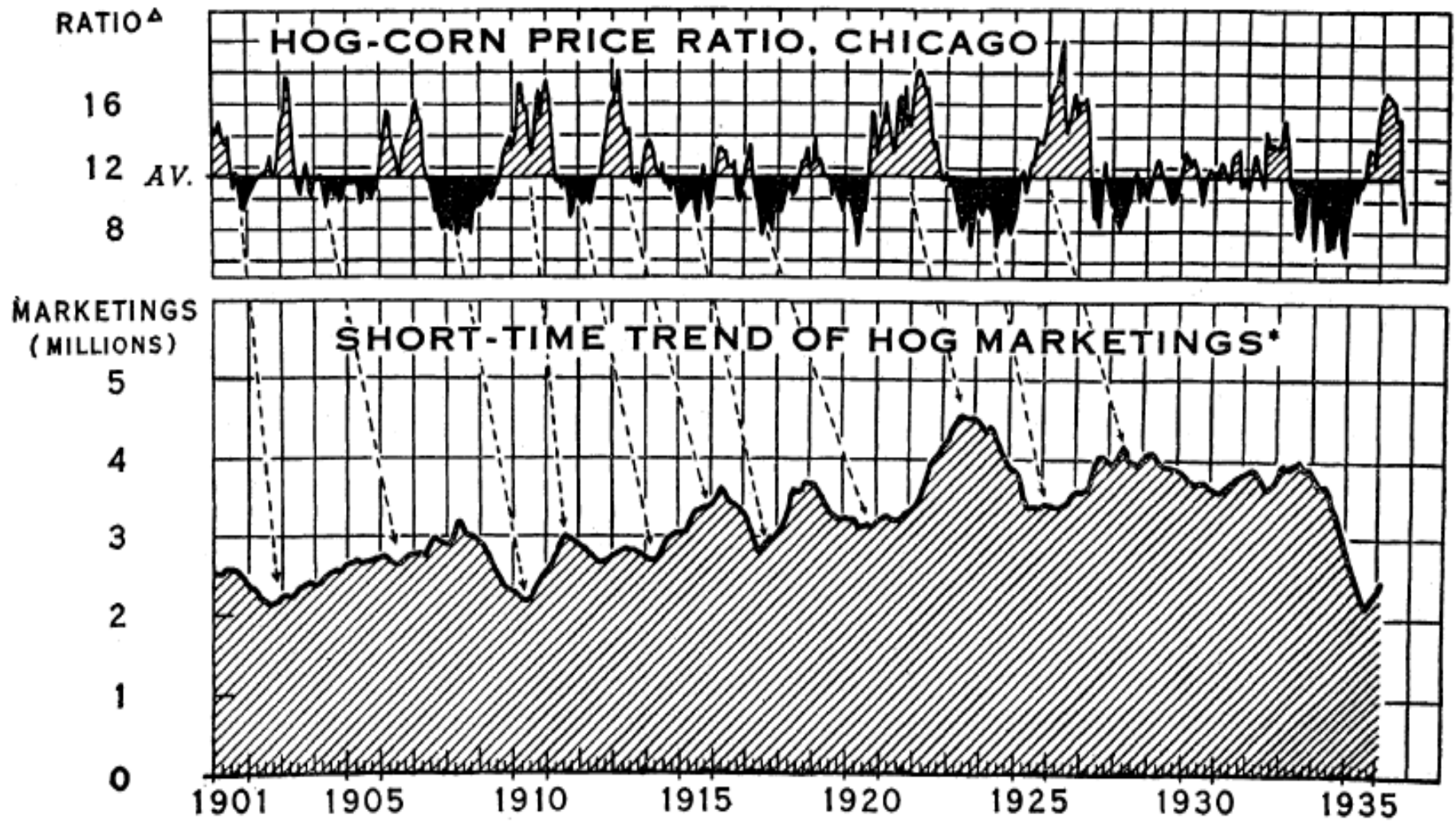 Is there a "Pig Cycle" in the labour supply of doctors? How training and immigration policies respond to physician shortages

Yasser Moullan, IMI, University of Oxford and IRDES
Xavier Chojnicki, University of Lille and CEPII
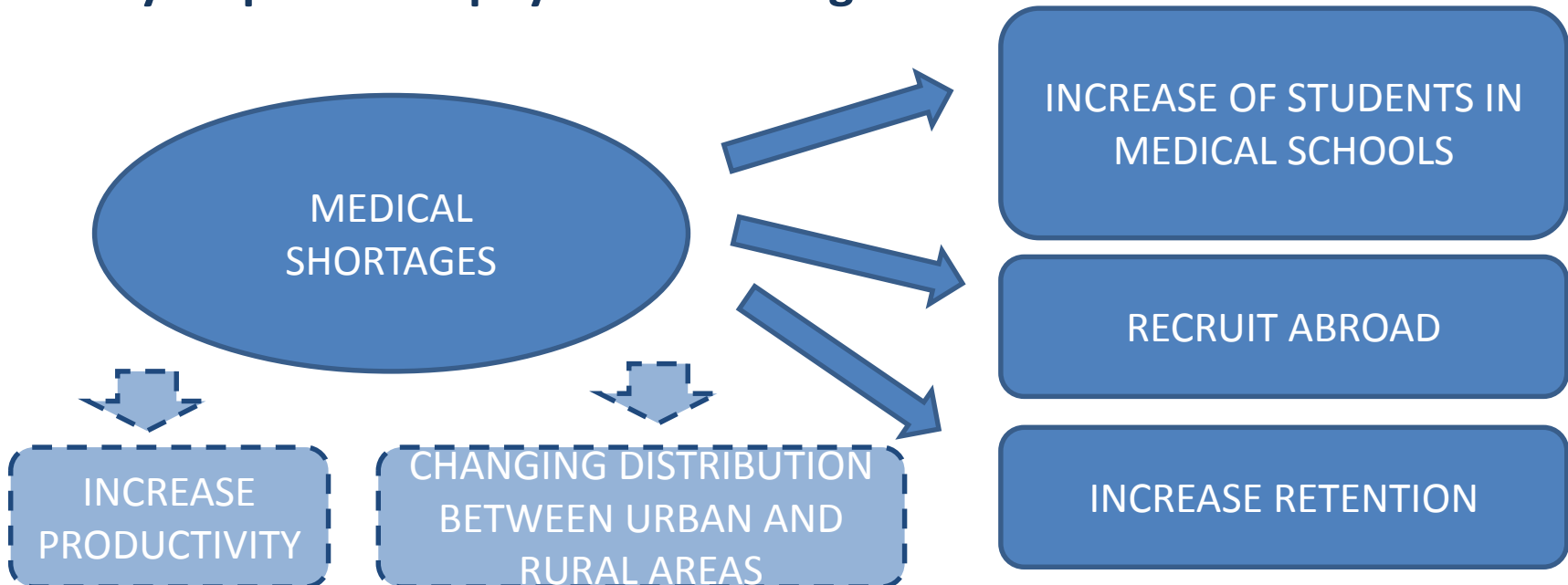
HOG-CORN PRICE RATIOS AND HOG MARKETINGS

* 12-MONTH MOVING AVERAGE OF HOG SLAUGHTER, FEDERALLY INSPECTED
▲ AVERAGE PRICE OF HOGS AND NO. 3 YELLOW CORN

Ezekiel (1938), "The Cobweb Theory" Quarterly Journal of Economics

2

What about medical doctors?

Appearance of medical shortages in OECD countries

- US: Deficit of 200,000 physicians for 2020-2025 (Cooper, 2004)
- UK: Estimated shortage of 20% for 2020 (Wanless, 2002)
- France: Supply should decrease until 2025

Policy responses of physician shortages

MEDICAL SHORTAGES

INCREASE OF STUDENTS IN MEDICAL SCHOOLS

RECRUIT ABROAD

INCREASE RETENTION

INCREASE PRODUCTIVITY

CHANGING DISTRIBUTION BETWEEN URBAN AND RURAL AREAS

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MEDICAL SHORTAGES
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STUDENTS IN MEDICAL SCHOOLS          RECRUITMENT FROM ABROAD          EMIGRATION OF PRACTISING PHYSICIANS
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DURATION OF MEDICAL TRAINING:

-US: 5 years before residency
-EU: 7-10 years
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REDUCE SHORTAGE IN THE SHORT-RUN          INCREASE SHORTAGE IN THE SHORT-RUN
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REDUCE SHORTAGE IN THE LONG-RUN
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1. **<u>How</u> do policy makers react to shortage of physicians ?**

   ▪ Training investment in medical schools

   ▪ Recruitment of foreign-trained physicians

   ▪ What about the practising physician workforce?

2. **<u>What</u> is the magnitude of these policies' responses?**

3. **<u>When </u>are these policies effective in addressing medical shortages?**

1. Medical graduates from 1991 to 2012 (Health OECD data)
   - Number of medical graduates over 1,000 physicians

2. Immigration and emigration from 1991 to 2004 (Bhargava et al. 2011)
   - Country of qualification as definition
   - Collection from OECD medical associations
   - Immigration= Foreign-trained/physicians
   - Emigration rate= Physicians abroad/(physicians + physicians abroad)

3. Shortage of physicians from 1991 to 2004

   In the literature:
   - Different definitions: needs, demand, service
   - Different level: country, regional (urban/rural), city level
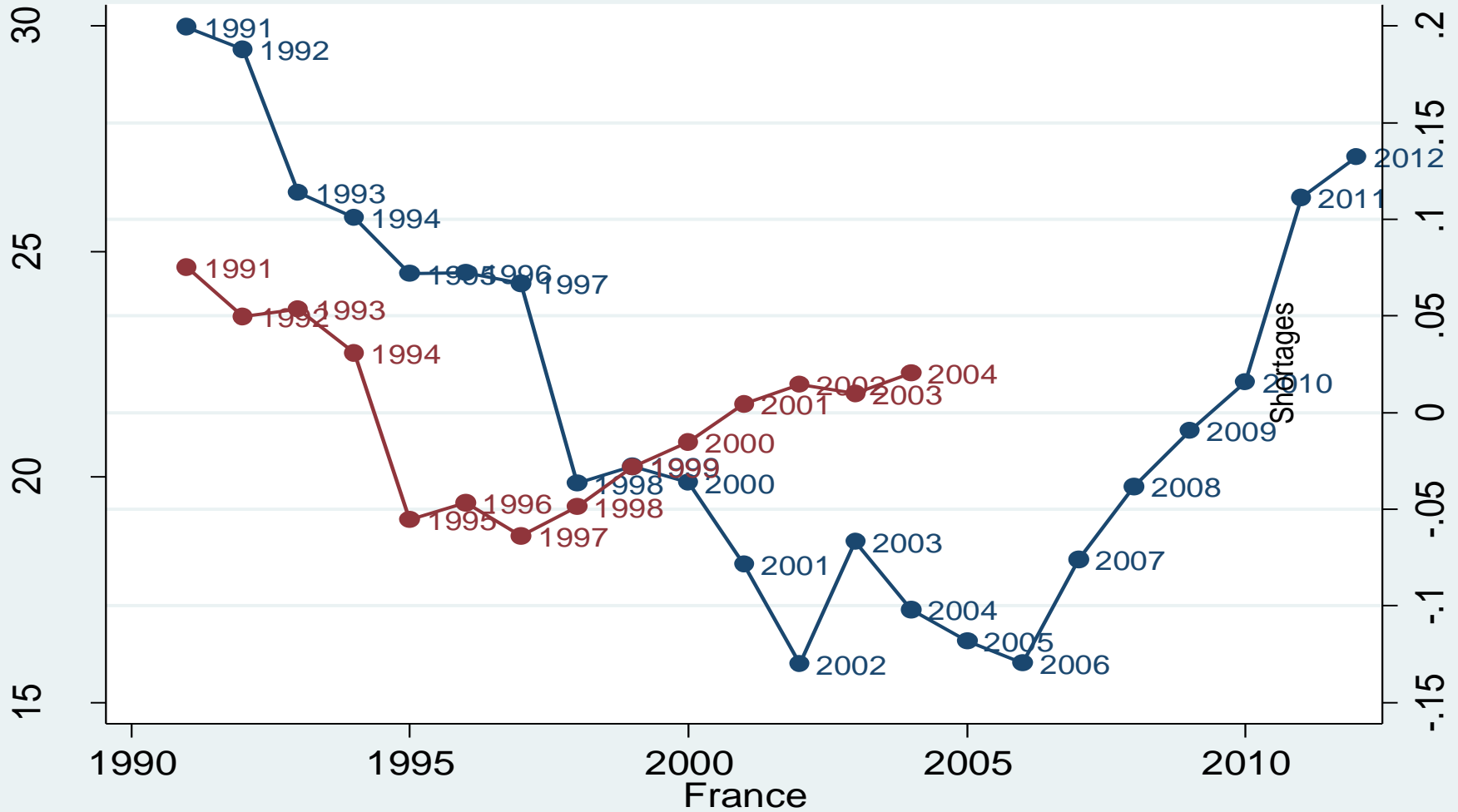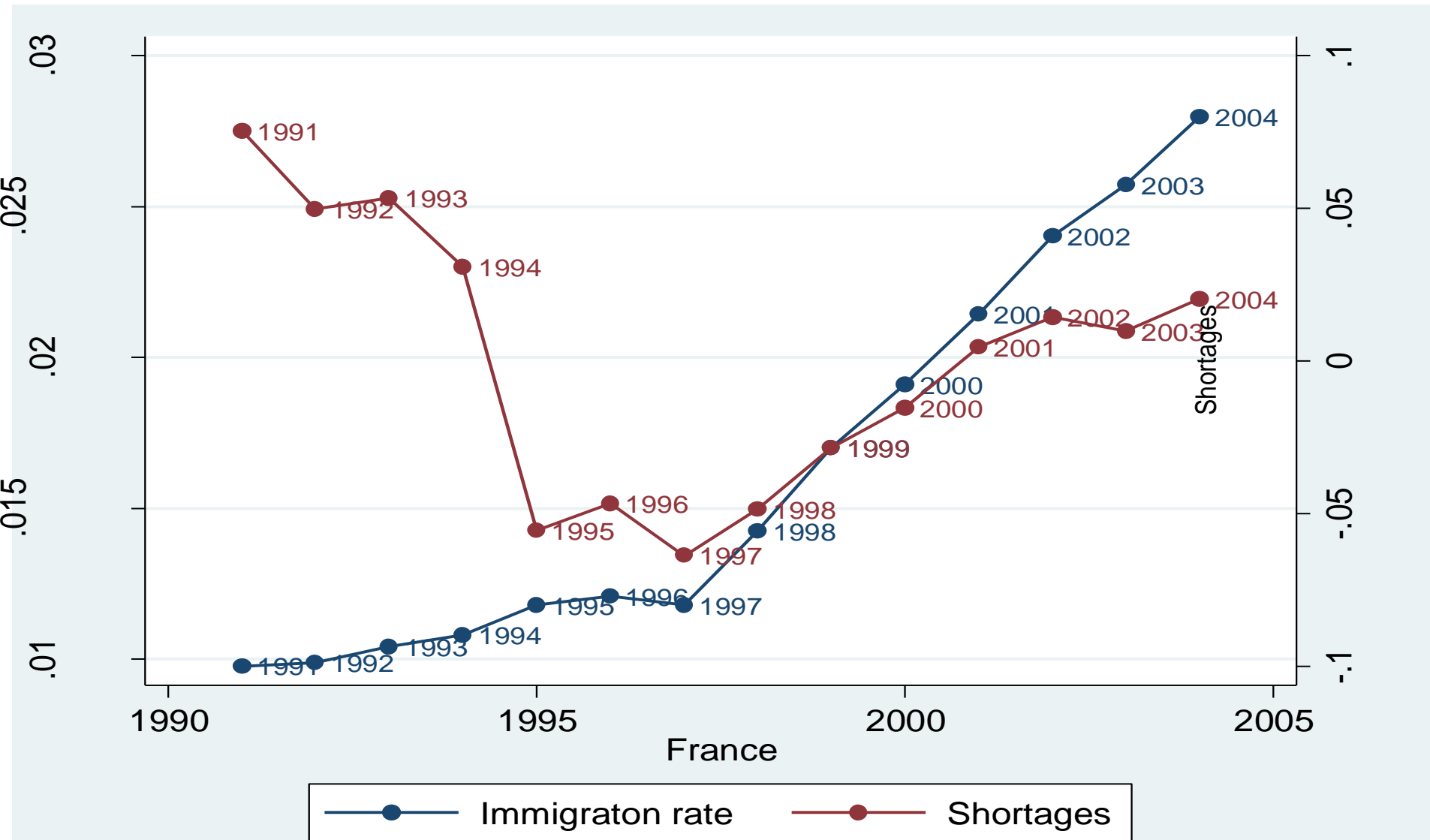   - Measure: number of physicians over 1,000 population (WHO, WDI data)

Definition

- Demand of physicians is the best predictor of the GDP per capita (Cooper et al. 2003, Scheffler et al. 2008)

Measurement

$$Ln(\text{Actual Physicians per } 1000_{j,t}) = \alpha_0 + \alpha_1 Ln(\text{GDP per capita}_{j,t}) + \varphi_j + \varepsilon_{j,t}$$

$$\text{Shortage}_{j,t} = Ln(\text{Predicted Physicians per } 1000_{j,t}) - Ln(\text{Actual Physicians per } 1000_{j,t})$$

	Average predicted density of physicians per 1,000 people	Average density of physicians per 1,000 people	Shortage in level= predicted density-observed density
1991	2,610	2,554	0,057
1992	2,636	2,620	0,016
1993	2,655	2,668	-0,013
1994	2,700	2,717	-0,018
1995	2,742	2,749	-0,007
1996	2,778	2,810	-0,032
1997	2,824	2,789	0,035
1998	2,861	2,844	0,017
1999	2,906	2,966	-0,060
2000	2,972	3,041	-0,069
2001	3,006	3,085	-0,079
2002	3,040	3,021	0,018
2003	3,062	3,021	0,040
2004	3,111	3,021	0,090

France

France
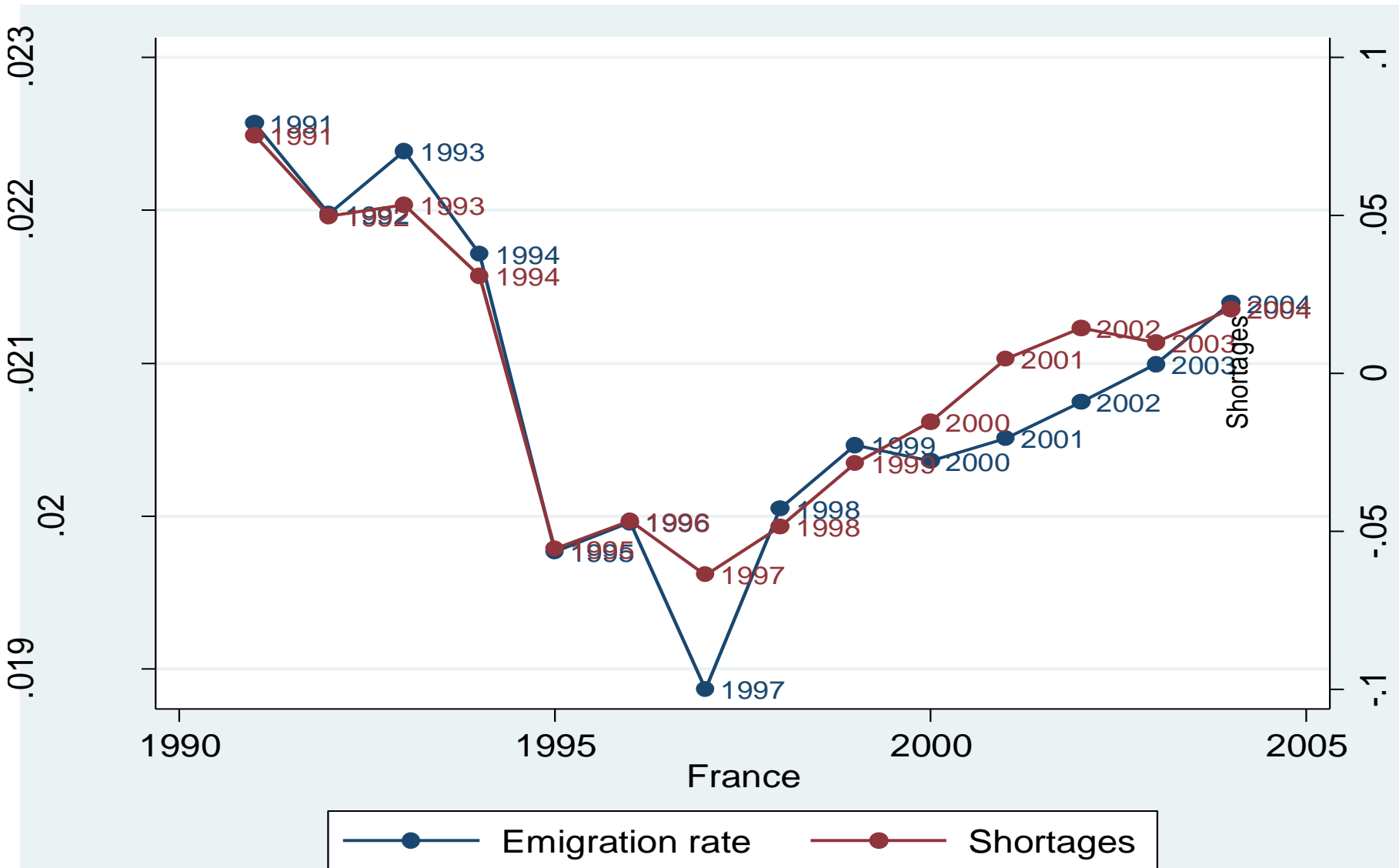
$$Ln\left[\left(\frac{\text{Medical graduates}}{\text{Physicians}}*1{,}000\right)_{j,t+\gamma}\right] = \beta_0 + \beta_1\,\text{Shortages}_{j,t} + \beta_2\,Ln(X_{j,t}) + FE_j + FE_t + v_{j,t}$$

$$Ln\,(\text{Immigration rate}_{j,t}) = \beta_0 + \beta_1\,\text{Shortages}_{j,t} + \beta_2\,Ln\,(X_{j,t}) + FE_j + FE_t + \eta_{j,t}$$

$$Ln\,(\text{Emigration rate}_{i,t}) = \beta_0 + \beta_1\,\text{Shortages}_{i,t} + \beta_2\,Ln\,(X_{i,t}) + FE_i + FE_t + \mu_{i,t}$$

Controls= Age dependency ratio, social expenditure, GDP per capita, school enrolment, immigration policy

- **Methodology**
  - Panel fixed effect analysis (country and time FE)
  - Endogeneity bias: IV estimations where geographical density and ageing of physicians used as instruments
  - Simultaneity bias: SURE and 3SLS for tackling endogeneity

Medical Graduates Results

VARIABLES	(1) OLS Average over t+1 and t+2 Ln(Graduates)	(2) OLS Average over t+5, t+6 and t+7 Ln(Graduates)	(3) OLS Average over t+8 and t+9 Ln(Graduates)
(Shortage)t	0.191 (0.141)	0.449*** (0.140)	0.363*** (0.136)
Ln(Tertiary school enrolment)t	-0.0647 (0.112)	-0.310*** (0.0819)	-0.215*** (0.0735)
Ln(Secondary school enrolment)t	0.305** (0.140)	0.240** (0.115)	0.177 (0.110)
Ln(Population)t	-0.645 (0.865)	-2.332*** (0.693)	-1.406** (0.701)
Ln(Age dependency)t	-1.748*** (0.432)	-0.839** (0.361)	0.779** (0.342)
Ln(GDP per cap)t	-0.903** (0.395)	0.225 (0.277)	1.203*** (0.275)
Ln(Social expenditure per cap)t	0.943*** (0.229)	0.813*** (0.164)	0.295** (0.137)
Constant	13.23 (16.42)	29.12*** (10.32)	16.87 (13.44)
Observations	213	226	224
R-squared	0.803	0.833	0.857
j	YES	YES	YES
t	YES	YES	YES
Cluster	jt	jt	jt

Immigration and Emigration rate

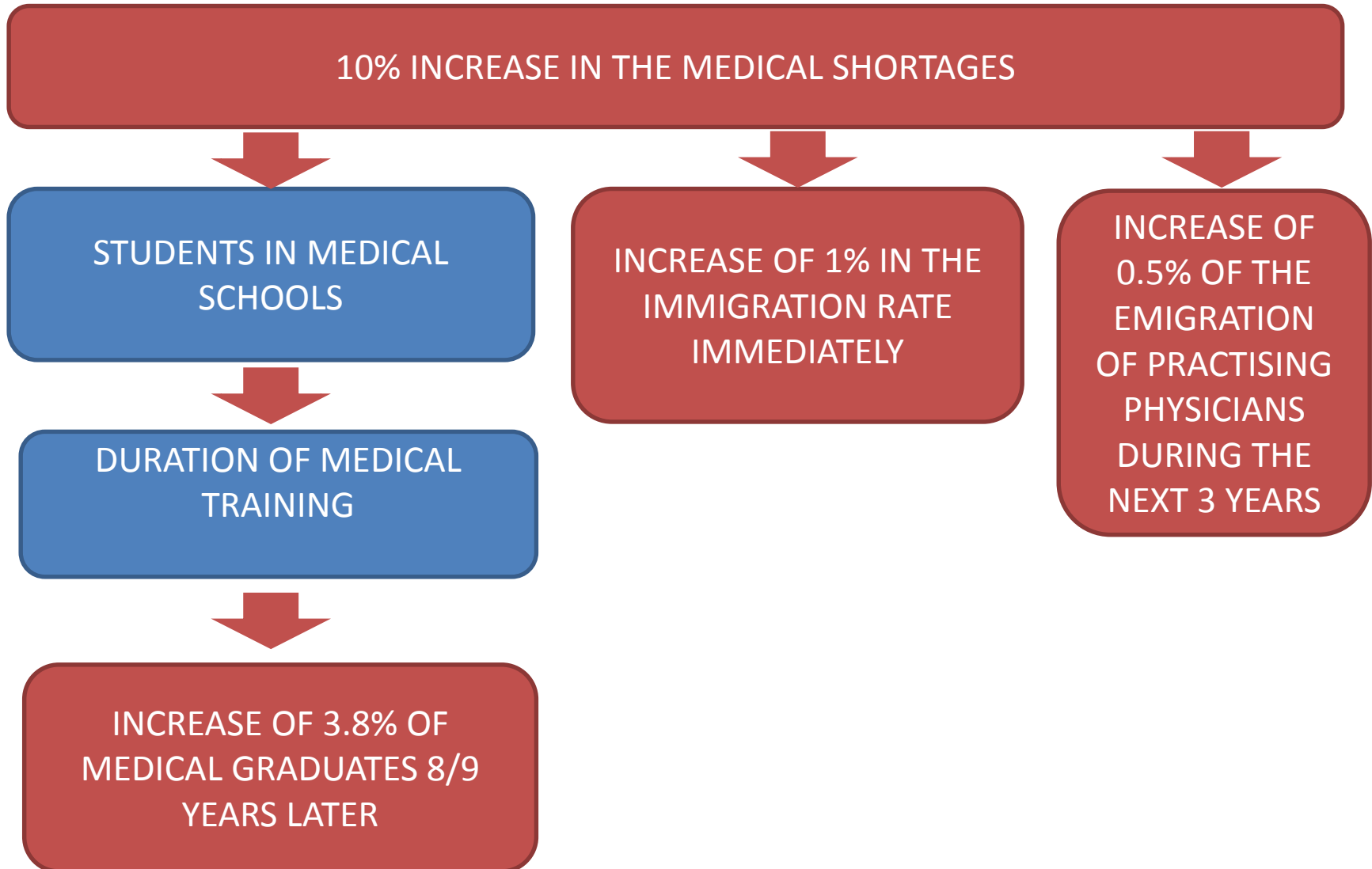| VARIABLES	(1) OLS Ln(IMR)	(2) OLS Ln(IMR)	(3) OLS Ln(IMR)	(4) OLS Ln(IMR)	(5) OLS Ln(EMR)	(6) OLS Ln(EMR)	(7) OLS Ln(EMR)	(8) OLS Ln(EMR)
(Shortage)t	0.165*** (0.0598)				0.0588*** (0.0133)			
(Shortage)t-1		0.0974* (0.0571)				0.0339** (0.0139)		
(Shortage)t-2			0.0312 (0.0476)				0.0381*** (0.0135)	
(Shortage)t-3				-0.0216 (0.0489)				0.0277** (0.0138)
Ln(Population)t	-0.496* (0.290)	-0.436 (0.330)	-0.392 (0.360)	-0.351 (0.427)	-0.625*** (0.101)	-0.630*** (0.113)	-0.666*** (0.126)	-0.633*** (0.147)
Ln(Age dependency)t	0.00642 (0.0664)	0.106 (0.0743)	0.179** (0.0828)	0.208** (0.103)	-0.0473 (0.0300)	-0.0326 (0.0312)	-0.0345 (0.0308)	-0.0293 (0.0330)
Ln(GDP per cap)t	0.211 (0.170)	0.187 (0.175)	0.135 (0.177)	0.0759 (0.176)	0.0102 (0.0233)	0.0334 (0.0244)	0.0476* (0.0272)	0.0490* (0.0295)
Ln(Social expenditure per cap)t	-0.136** (0.0611)	-0.175** (0.0681)	-0.215*** (0.0735)	-0.270*** (0.0861)	-0.0483*** (0.0170)	-0.0485*** (0.0180)	-0.0492*** (0.0169)	-0.0472*** (0.0181)
(Immig change level)t	0.000253 (0.00708)	0.000849 (0.00771)	0.00120 (0.00799)	-0.00196 (0.00889)	-0.00230 (0.00182)	-0.00322* (0.00187)	-0.00311 (0.00191)	-0.00123 (0.00208)
(Immig restrictivness)t	-0.0122 (0.0189)	-0.0131 (0.0205)	-0.0141 (0.0209)	-0.0244 (0.0237)	-0.00560 (0.00426)	-0.00660 (0.00450)	-0.00630 (0.00461)	-0.000896 (0.00514)
Constant	7.176 (4.978)	8.411 (6.868)	8.608 (7.733)	7.432 (7.441)	10.28*** (1.490)	12.24*** (2.043)	12.84*** (2.261)	9.732*** (2.066)
Observations	237	220	203	186	237	220	203	186
R-squared	0.926	0.933	0.939	0.944	0.988	0.989	0.989	0.990
j	YES	YES	YES	YES	YES	YES	YES	YES
t	YES	YES	YES	YES	YES	YES	YES	YES
Cluster	jt	jt	jt	jt	jt	jt	jt	jt

IV Estimations

VARIABLES	(1) 2SLS Second Stage Average t+5, t+6 Ln(Graduates)	(2) 2SLS First Stage Shortage	(3) 2SLS Second Stage Average t+8 and t+9 Ln(Graduates)	(4) 2SLS First Stage Shortage	(5) 2SLS Second Stage Ln(IMR)	(6) 2SLS First Stage Shortage	(7) 2SLS Second Ln(EMR)	(8) 2SLS First Stage Shortage
(Shortage)t	0.299** (0.130)		0.398*** (0.106)		0.114*** (0.0242)		0.0539*** (0.0151)	
Ln(Tertiary enrolment)t	-0.266*** (0.0727)	-0.00357 (0.00258)	-0.297*** (0.0656)	-0.000186 (0.00251)				
Ln(Secondary enrolment)t	0.188* (0.0988)	-0.00467 (0.00346)	0.262*** (0.0939)	-0.00532 (0.00356)				
Ln(Population)t	-1.613** (0.664)	1.041*** (0.0223)	-0.408 (0.586)	1.071*** (0.0199)	0.340*** (0.0967)	1.063*** (0.0205)	-0.661*** (0.0950)	1.063*** (0.0205)
Ln(Age dependency)t	-0.920** (0.371)	-0.0270** (0.0106)	-0.189 (0.302)	-0.0250** (0.0113)	-0.105** (0.0422)	-0.0235** (0.0108)	-0.0560 (0.0360)	-0.0235** (0.0108)
Ln (GDP per cap)t	0.377 (0.276)	0.258*** (0.0145)	0.510** (0.259)	0.258*** (0.0143)	-0.281*** (0.0477)	0.260*** (0.0142)	0.0519 (0.0356)	0.260*** (0.0142)
Ln (Social exp cap)t	0.255 (0.165)	0.0140** (0.00642)	0.413*** (0.139)	0.00732 (0.00569)	0.0381 (0.0278)	0.00855 (0.00587)	-0.102*** (0.0270)	0.00855 (0.00587)
(Immig change level)t					0.00105 (0.00153)	-0.000398 (0.000347)	-0.00256 (0.00187)	-0.000398 (0.000347)
(Immig restrict)t					0.00241 (0.00341)	0.000171 (0.000786)	-0.00702 (0.00439)	0.000171 (0.000786)
Ln(Physician/geo)t		-0.994*** (0.00493)		-0.992*** (0.00539)		-0.991*** (0.00528)		-0.991*** (0.00528)
Ln(Physician dependency)t		0.00393** (0.00183)		0.00372** (0.00181)		0.00297* (0.00170)		0.00297* (0.00170)
Constant	27.35** (12.86)	-11.51*** (0.422)	2.128 (11.33)	-12.06*** (0.371)	-3.912** (1.703)	-11.97*** (0.376)	13.12*** (1.749)	-11.97*** (0.376)
Observations	193	193	188	188	195	195	195	195
R-squared	0.815		0.861		0.989		0.967	
j	YES	YES	YES	YES	YES	YES	YES	YES
t	YES	YES	YES	YES	YES	YES	YES	YES
Cluster	it	it	it	it	it	it	it	it
Hansen		1.379		1.790		1.620		1.376
P-Value (Hansen Test)		0.240		0.181		0.203		0.241
F-Test		47.28		30.32		959.7		138.3

VARIABLES	(4) 3SLS Average over t+5, t+6 and t+7 Ln(Graduates)	(5) 3SLS Ln(IMR)	(6) 3SLS Ln(EMR)
(Shortage)t	0.315** (0.135)	0.118*** (0.0218)	0.0337** (0.0151)

VARIABLES	(4) 3SLS Average over t+8 and t+9 Ln(Graduates)	(5) 3SLS Ln(IMR)	(6) 3SLS Ln(EMR)
(Shortage)t	0.378*** (0.116)	0.111*** (0.0216)	0.0555*** (0.0166)

- Endogeneity
  - Similar results except for the medical graduate model
  - Coefficient of shortage is higher for average graduates between t+8 and t+9 than those between t+5 and t+7
  - "Pig Cycle" appears with 8 and 9 years delay
  - Robustness of instruments
    - Local shortage explains national shortage
    - Ageing of physician population drives up the national shortage

- Simultaneity
  - Similar results and confirm the delay of 8/9 years

10% INCREASE IN THE MEDICAL SHORTAGES

STUDENTS IN MEDICAL SCHOOLS

INCREASE OF 1% IN THE IMMIGRATION RATE IMMEDIATELY

INCREASE OF 0.5% OF THE EMIGRATION OF PRACTISING PHYSICIANS DURING THE NEXT 3 YEARS

DURATION OF MEDICAL TRAINING

INCREASE OF 3.8% OF MEDICAL GRADUATES 8/9 YEARS LATER

Trade-off between education and development policy in OECD countries

o Education
  - Investing in medical school capacities
  - Only efficient in the long run
  - Financial cost of training

o Development policy
  - Recruitment of foreign-trained physicians from abroad
  - Risk of deprivation of origin countries of their human resources for health
  - Adoption of Code of Good Practice in WHO member states and Commonwealth area

THANK YOU FOR YOUR ATTENTION

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