

Spatial Patterns of Steam Technology Diffusion in
Nineteenth-Century France
-Supplementary Material-

October 4, 2024

Supplementary Material

Table S1: Estimation Results: POLS, continuation from Table 4 in the main paper.

	(1)	(2)	(3)
<i>Calendar year (Q_t)</i>			
1851	0.025*** (0.005)	0.007 (0.015)	-0.019* (0.008)
1856	0.113*** (0.015)	0.0801* (0.031)	0.035* (0.017)
1861	0.224*** (0.024)	0.131* (0.057)	0.02 (0.034)
1866	0.345*** (0.037)	0.183* (0.09)	-0.002 (0.054)
1871	0.471*** (0.047)	0.206 (0.131)	-0.061 (0.078)
1876	0.638*** (0.062)	0.301 (0.157)	-0.0287 (0.094)
1881	0.880*** (0.072)	0.428* (0.194)	0.022 (0.120)
1886	1.105*** (0.077)	0.467 (0.246)	-0.039 (0.163)
1891	1.280*** (0.084)	0.481 (0.298)	-0.117 (0.198)
1896	1.496*** (0.09)	0.578 (0.337)	-0.093 (0.225)
1901	1.714*** (0.098)	0.639 (0.384)	-0.125 (0.261)
1906	1.834*** (0.103)	0.632 (0.419)	-0.219 (0.289)
1911	1.947*** (0.097)	0.671 (0.449)	-0.219 (0.313)
Constant	0.091*** (0.015)	7.059 (5.944)	0.015 (0.102)

Cluster robust standard errors in parentheses

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

Robustness check: Alternative distance threshold 500KM

Table S2: Estimation results: First difference models as in equation (2) in the paper.

	(4)	(5)	(6)	(7)	(8)
	POLS	P2SLS	S2SLS	S2SLS	FD-GMM
<i>Autoregressive process ($\Delta Y_{r,t-1}$)</i>					
Machines per 1000 inhabitants (5yr lag)		<u>0.300</u> *	<u>0.332</u> *	<u>0.304</u> *	<u>0.550</u> ***
		(0.151)	(0.149)	(0.150)	(0.0827)
<i>Time varying (ΔX_{rt})</i>					
Literacy rate (5yr lag)	-0.001	0.0001	0.001	<u>-0.002</u>	<u>0.04</u>
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
<i>Space time diffusion ($\Delta W_{r,t-1}$)</i>					
Machines, <150KM (5yr lag)	0.499***	0.349*	<u>0.600</u> **	<u>0.589</u> **	<u>0.563</u> ***
	(0.108)	(0.149)	(0.226)	(0.225)	(0.123)
Machines, 150-500KM (5yr lag)	0.095	0.098	0.131	0.890	0.211
	(0.212)	(0.198)	(0.200)	(0.206)	(0.214)
<i>Included but not reported:</i>					
	Q_t	Q_t	Q_t	Q_t	Q_t
Observations	1104	1101	1016	1016	1100

Cluster robust standard errors in parentheses

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

Underlined: Instrumented Variable

Robustness check: Adding Distance threshold >300KM

Table S3: Estimation results: First difference models as in equation (2) in the paper.

	(4)	(5)	(6)	(7)	(8)
	POLS	P2SLS	S2SLS	S2SLS	FD-GMM
<i>Autoregressive process ($\Delta Y_{r,t-1}$)</i>					
Machines per 1000 inhabitants (5yr lag)		<u>0.305</u> *	<u>0.357</u> *	<u>0.206</u>	<u>0.550</u> ***
		(0.147)	(0.149)	(0.153)	(0.08)
<i>Time varying (ΔX_{rt})</i>					
Literacy rate (5yr lag)	0.0002	0.001	0.0003	<u>-0.004</u>	<u>0.004</u>
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
<i>Space time diffusion ($\Delta W_{r,t-1}$)</i>					
Machines, <150KM (5yr lag)	0.178	0.177	<u>0.617</u>	<u>0.781</u> *	<u>0.542</u> **
	(0.118)	(0.097)	(0.344)	(0.375)	(0.209)
Machines, 150-300KM (5yr lag)	-0.422	-0.167	0.301	0.336	0.272
	(0.269)	(0.344)	(0.396)	(0.402)	(0.279)
Machines, >300KM (5yr lag)	-1.934**	-0.975	0.702	0.864	0.317
	(0.660)	(0.930)	(1.217)	(1.275)	(0.749)
<i>Included but not reported:</i>					
	Q_t	Q_t	Q_t	Q_t	
Observations	1104	1101	1016	1100	

Cluster robust standard errors in parentheses

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

Underlined: Instrumented Variable

Robustness check: Drop Paris

Table S4: Estimation results: First difference models as in equation (2) in the paper.

	(4)	(5)	(6)	(7)	(8)
	POLS	P2SLS	S2SLS	S2SLS	FD-GMM
<i>Autoregressive process ($\Delta Y_{r,t-1}$)</i>					
Machines per 1000 inhabitants (5yr lag)		<u>0.307*</u> (0.156)	<u>0.350*</u> (0.150)	<u>0.317*</u> (0.151)	<u>0.585***</u> (0.0783)
<i>Time varying (ΔX_{rt})</i>					
Literacy rate (5yr lag)	-0.001 (0.002)	0.0001 (0.002)	0.001 (0.002)	<u>-0.002</u> (0.003)	<u>0.003</u> (0.002)
<i>Space time diffusion ($\Delta W_{r,t-1}$)</i>					
Machines, <150KM (5yr lag)	0.493*** (0.116)	0.342* (0.163)	<u>0.647**</u> (0.245)	<u>0.652**</u> (0.242)	<u>0.492***</u> (0.134)
Machines, 150-300KM (5yr lag)		0.167 (0.112)	0.051 (0.092)	0.135 (0.114)	(0.126)
<i>Included but not reported:</i>					
	Q_t	Q_t	Q_t	Q_t	Q_t
Observations	1091	1088	1004	1004	1087

Cluster robust standard errors in parentheses

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

Underlined: Instrumented Variable

Robustness check: Drop land border departments

Table S5: Estimation results: First difference models as in equation (2) in the paper.

	(4)	(5)	(6)	(7)	(8)
	POLS	P2SLS	S2SLS	S2SLS	FD-GMM
<i>Autoregressive process ($\Delta Y_{r,t-1}$)</i>					
Machines per 1000 inhabitants (5yr lag)		<u>0.105</u>	<u>0.142</u>	<u>0.0645</u>	<u>0.492***</u>
		(0.173)	(0.190)	(0.207)	(0.0814)
<i>Time varying (ΔX_{rt})</i>					
Literacy rate (5yr lag)	-0.0001	0.0003	0.001	<u>0.003</u>	<u>0.003</u>
	(0.002)	(0.002)	(0.002)	(0.004)	(0.003)
<i>Space time diffusion ($\Delta W_{r,t-1}$)</i>					
Machines, <150KM (5yr lag)	0.532**	0.484**	<u>0.975***</u>	<u>1.013***</u>	<u>0.638***</u>
	(0.161)	(0.179)	(0.255)	(0.252)	(0.159)
Machines, 150-300KM (5yr lag)	0.074	0.064	-0.063	-0.082	0.069
	(0.132)	(0.124)	(0.132)	(0.139)	(0.136)
<i>Included but not reported:</i>					
	Q_t	Q_t	Q_t	Q_t	Q_t
Observations	886	886	817	817	885

Cluster robust standard errors in parentheses

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

Underlined: Instrumented Variable

Robustness check: Adding current literacy rate

Table S6: Estimation results: First difference models as in equation (2) in the paper.

	(4)	(5)	(6)	(8)
	POLS	P2SLS	S2SLS	FD-GMM
<i>Autoregressive process ($\Delta Y_{r,t-1}$)</i>				
Machines per 1000 inhabitants (5yr lag)		<u>0.273</u>	<u>0.320*</u>	<u>0.574***</u>
		(0.161)	(0.151)	(0.076)
<i>Time varying (ΔX_{rt})</i>				
Literacy rate	-0.002	-0.002	-0.001	<u>-0.011*</u>
	(0.002)	(0.002)	(0.002)	(0.005)
Literacy rate (5yr lag)	-0.0005	0.0003	0.0007	<u>0.001**</u>
	(0.002)	(0.002)	(0.002)	(0.005)
<i>Space time diffusion ($\Delta W_{r,t-1}$)</i>				
Machines, <150KM (5yr lag)	0.463***	0.334*	<u>0.057*</u>	<u>0.490***</u>
	(0.113)	(0.158)	(0.238)	(0.137)
Machines, 150-300KM (5yr lag)	0.198	0.148	0.052	0.098
	(0.115)	(0.096)	(0.113)	(0.128)
<i>Included but not reported:</i>				
	Q_t	Q_t	Q_t	Q_t
Observations	1104	1101	1016	1100

Cluster robust standard errors in parentheses

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

Underlined: Instrumented Variable

Robustness check: Adding population density

Table S7: Estimation results: First difference models as in equation (2) in the paper.

	(4)	(5)	(6)	(7)	(8)
	POLS	P2SLS	S2SLS	S2SLS	FD-GMM
<i>Autoregressive process ($\Delta Y_{r,t-1}$)</i>					
Machines per 1000 inhabitants (5yr lag)		<u>0.310</u> *	<u>0.428</u> **	<u>0.348</u> *	<u>0.609</u> ***
		(0.153)	(0.156)	(0.163)	(0.071)
<i>Time varying (ΔX_{rt})</i>					
Population density	-0.033***	-0.026***	-0.027***	-0.03***	-0.022***
	(0.003)	(0.005)	(0.006)	(0.007)	(0.004)
Literacy rate (5yr lag)	-0.001	0.0002	0.001	<u>-0.002</u>	<u>0.004</u>
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
<i>Space time diffusion ($\Delta W_{r,t-1}$)</i>					
Machines, <150KM (5yr lag)	0.488***	0.337*	<u>0.537</u> *	<u>0.620</u> *	<u>0.474</u> ***
	(0.114)	(0.161)	(0.254)	(0.260)	(0.136)
Machines, 150-300KM (5yr lag)	0.226*	0.162	0.0517	0.04	0.144
	(0.111)	(0.091)	(0.107)	(0.112)	(0.125)
<i>Included but not reported:</i>					
	Q_t	Q_t	Q_t	Q_t	Q_t
Observations	1101	1098	1013	1013	1097

Cluster robust standard errors in parentheses

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

Underlined: Instrumented Variable

Robustness check: Addition of industry information

Table S8: Estimation results: POLS models as in equation (1) in the paper.

<i>Time varying (X_{rt})</i>		
Literacy rate (5 year lag)	-0.001 (0.003)	-0.005 (0.003)
<i>Space time diffusion ($W_{r,t-1}$)</i>		
Machines per 1000 inhabitants, <150KM (5 year lag)	1.037*** (0.143)	0.794*** (0.162)
Machines per 1000 inhabitants, 150-300KM (5 year lag)	0.058 (0.193)	-0.207 (0.219)
<i>Industry sector information ($\in V_r$)</i>		
Textile (present)	-0.150 (0.141)	-0.177 (0.123)
Metal (present)	0.150 (0.093)	0.102 (0.08)
Steel (present)	0.081 (0.09)	-0.047 (0.08)
Extraction (present)	-0.118 (0.109)	-0.148 (0.098)
Textile (dominant)	0.092 (0.146)	-0.017 (0.152)
Metal (dominant)	-0.0768 (0.142)	-0.176 (0.145)
Steel (dominant)	-0.002 (0.151)	-0.013 (0.145)
Extraction (dominant)	0.031 (0.159)	-0.011 (0.126)
<i>Included but not reported:</i>		
	Q_t	Q_t, V_r
Observations	260	236
Cluster robust standard errors in parentheses		
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$		

Robustness check: Adding intermediate human capital

Table S9: Estimation results: POLS models as in equation (1) in the paper.

	(1)	(2)	(3)	(4)
<i>Time varying (X_{rt})</i>				
literacy rate (5 year lag)	-0.005*	-0.005*	0.0004	0.0005
	(0.002)	(0.002)	(0.002)	(0.002)
intermediate human capital (5 year lag)		0.00001		0.00002
		(0.000)		(0.000)
<i>Space time diffusion ($W_{r,t-1}$)</i>				
machines per 1000 inhabitants, <150KM (5 year lag)	0.686***	0.639***	1.016***	0.915***
	(0.162)	(0.162)	(0.152)	(0.157)
machines per 1000 inhabitants, 150-300KM (5 year lag)	-0.044	-0.03	0.097	0.112
	(0.208)	(0.203)	(0.198)	(0.192)
<i>Included but not reported:</i>				
	Q_t, V_r	Q_t, V_r	Q_t	Q_t
Observations	476	476	593	593

Standard errors in parentheses

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

Robustness check: Adding population density - without Paris

Table S10: Estimation results: First difference models as in equation (2) in the paper.

	(4)	(5)	(6)	(7)	(8)
	POLS	P2SLS	S2SLS	S2SLS	FD-GMM
<i>Autoregressive process ($\Delta Y_{r,t-1}$)</i>					
Machines per 1000 inhabitants (5yr lag)		<u>0.352</u> *	<u>0.507</u> **	<u>0.474</u> **	<u>0.641</u> ***
		(0.169)	(0.159)	(0.156)	(0.07)
<i>Time varying (ΔX_{rt})</i>					
Population density	-0.128	-0.216	-0.363*	-0.355*	-0.181
	(0.192)	(0.174)	(0.154)	(0.153)	(0.167)
Literacy rate (5yr lag)	-0.001	0.0004	0.001	<u>-0.001</u>	<u>0.004</u> *
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
<i>Space time diffusion ($\Delta W_{r,t-1}$)</i>					
Machines, <150KM (5yr lag)	0.496***	0.326	<u>0.517</u> *	<u>0.529</u> *	<u>0.457</u> **
	(0.117)	(0.169)	(0.262)	(0.256)	(0.142)
Machines, 150-300KM (5yr lag)	0.225*	0.146	0.021	0.017	0.131
	(0.113)	(0.091)	(0.109)	(0.111)	(0.122)
<i>Included but not reported:</i>					
	Q_t	Q_t	Q_t	Q_t	Q_t
Observations	1088	1085	1001	1001	1084

Cluster robust standard errors in parentheses

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

Underlined: Instrumented Variable

Robustness check: Alternative spatial weighting

Table S11: Estimation results: First difference models as in equation (2) in the paper.

	(4)	(5)	(6)	(7)	(8)
	POLS	P2SLS	S2SLS	S2SLS	FD-GMM
Average number of steam engines per 100.000 inhabitants in certain perimeter					
<i>Autoregressive process ($\Delta Y_{r,t-1}$)</i>					
Machines per 1000 inhabitants (5yr lag)		<u>0.307</u>	<u>0.390*</u>	<u>0.249</u>	<u>0.559***</u>
		(0.161)	(0.164)	(0.162)	(0.0842)
<i>Time varying (ΔX_{rt})</i>					
Literacy rate (5yr lag)	-0.001	-0.000	0.001	-0.003	0.004
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
<i>Space time diffusion ($\Delta W_{r,t-1}$)</i>					
Machines, <150KM (5yr lag)	0.498***	0.344*	<u>0.550*</u>	<u>0.662**</u>	<u>0.562***</u>
	(0.109)	(0.155)	(0.234)	(0.228)	(0.123)
Regional average of number of steam engines per 100.000 inhabitants in certain perimeter					
<i>Autoregressive process ($\Delta Y_{r,t-1}$)</i>					
Machines per 1000 inhabitants (5yr lag)		<u>0.203</u>	<u>0.125</u>	<u>-0.110</u>	<u>0.425***</u>
		(0.205)	(0.358)	(0.291)	(0.113)
<i>Time varying (ΔX_{rt})</i>					
Literacy rate (5yr lag)	-0.001	-0.000	0.001	<u>-0.001</u>	0.004
	(0.002)	(0.002)	(0.002)	(0.005)	(0.003)
<i>Space time diffusion</i>					
Machines, regional average of <150KM (5yr lag)	0.429***	0.324*	<u>0.852</u>	<u>1.153*</u>	<u>0.601***</u>
	(0.0972)	(0.164)	(0.542)	(0.475)	(0.171)
Regional average of number of steam engines per 100.000 inhabitants of direct neighbours (binary contiguity weights)					
<i>Autoregressive process ($\Delta Y_{r,t-1}$)</i>					
Machines per 1000 inhabitants (5yr lag)		<u>0.001</u>	<u>0.124</u>	<u>-0.136</u>	<u>0.606***</u>
		(0.267)	(0.307)	(0.268)	(0.131)
<i>Time varying (ΔX_{rt})</i>					
Literacy rate (5yr lag)	0.000	0.0001	0.001	<u>-0.006</u>	0.003
	(0.002)	(0.002)	(0.002)	(0.004)	(0.002)
<i>Space time diffusion</i>					
Machines, regional average of direct neighbours (5yr lag)	0.545***	0.544*	<u>0.658*</u>	<u>0.857**</u>	<u>0.308</u>
	(0.1)	(0.219)	(0.326)	(0.264)	(0.198)
<i>Included but not reported:</i>					
	Q_t	Q_t	Q_t	Q_t	Q_t
Observations	1104	1101	1016	1016	1100

Cluster robust standard errors in parentheses

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

Underlined: Instrumented Variable