Appendix

Table A1: Descriptive statistics

|  |  |  |
| --- | --- | --- |
| Stats | mean | sd |
| Patent fees in fl | 9.83 | 5.05 |
| Life span assigned in years | 6.08 | 2.48 |
| Life span realized in years | 4.62 | 2.67 |
| Patent of introduction (1=yes, 0=no) | 0.10 | 0.30 |
| World Fair’s exhibits (Number) | 702.03 | 1113.31 |
| Retaliation in fl | 18.68 | 31.01 |
| Distance to Stuttgart in km | 0.32 | 0.92 |
| Border to Wuerttemberg (1=, border; 0=no border) | 0.08 | 0.28 |
| Employment share per industry in percent | 6.53 | 8.76 |
| Patents per year (Number) | 54.39 | 31.75 |
| Prematurely cancelled (1=cancelled; 0= assigned life span=realized life span) | 0.42 | 0.49 |
| Difference assigned and realized life span in years | 1.46 | 2.26 |

Source: see text

Table A2: Country of residence: full sample and sub sample, 1844-1868

|  |  |  |
| --- | --- | --- |
|  | Sample for which we have information on fees | Full sample of patents after 1843 |
| Patentees’ country of residence | Total | In percent | Total | In percent |
| Wuerttemberg | 381 | 52.7 | 537 | 55.25 |
| German Customs Union | 196 | 27.11 | 254 | 26.13 |
| German states outside the Customs Union | 10 | 1.38 | 12 | 1.23 |
| Non-German states | 136 | 18.81 | 169 | 17.39 |
| Total | 723 | 100 | 972 | 100 |

Source: see text

Sectoral classification:

Following Donges and Selgert (2019a), we assigned each patent to one of 24 industries. The assignment was made in two steps. First, we allocated each patent based on its title to one of the 89 technological classes introduced by the Imperial Patent Office in 1877. Second, we used the mapping developed by Donges and Selgert (2019a) (see online-appendix ehr12703-sup-0001-SuppMat.docx) to match these 89 technological classes with the industries listed in the *Zollverein* survey (Deutscher Zollverein, 1964). We report the aggregation scheme in table A3. Note that the Zollverein survey does not include employment information for the mining sector and electrical engineering. We have no patents in the mining sector. In contrast to Donges and Selgert (2019), we classify electrical engineering as part of the machine sector.

Table A3: Aggregation of technology groups and industries

|  |  |  |
| --- | --- | --- |
| Industry | Technology classes (Imperial Patent Office)a | Zollverein employment statistic of 1861b |
| Factory employeesc | Craft employees |
| I. Textiles | 3 (clothing), 8 (textile-processing), 25 (lace), 41 (hats), *29 (textile countering yarn)* (52 (sewing), 73 (ropes), 76 (spinning), 86 (weaving) | I (spinning mills), II (weaving mills and processing of textiles), VIIIo (hats) | IX (production of spun yarn), X (finishing of fabrics), XII (garment production) |
| II. Coal, coke, and gas generation | 4 (lighting with gas), 5 (mining), 10 (solid fuels), 26 (gas generation) | Vd (coking plants and gas generation) | XVIg (charcoal burner) |
| IIIa. Metal production | 1 (processing of ores), 7 (metal sheet, metal tubes, wire, rolling of metal), 18 (iron metallurgy), 19 (railway superstructure), 31 (metal casting), 40 (non-ferrous metals and alloys) | III (metal production) | . |
| IIIb. Metal processing in general | 48 (chemical metal-working), 49 (mechanical metal-working), 87 (machine tools) |
| IVa. Steam power, locomotives, and railway waggons | 13 (steam boilers), 14 (steam engines), 20 (railway operations), 24 (firing installations), 47 (machine parts), *60 (controller for steam machines)* | IVa (machine building factories including shipbuilding), IVd (railway waggons) | VI (machine-building, vehicle construction, and ship-building) |
| IVb. Agricultural machinery | 45 (agricultural machinery) |
| IVc: Internal combustion engines | 46 (internal combustion engines) |
| IVd. Shipbuilding | 65 (shipbuilding) |
| IVe. Machine-building, various | 27 (blower), 35 (hoists), 36 (heating installations), 58 (squeezing machines), 59 (pumps), 81 (conveyors packaging machines), 88 (wind and water power machines). 21 (electrical engineering), 74 (signals) |
| V. Metal goods: | 43 (cash registers), 61 (fire service equipment), 63 (vehicle construction), 68 (locksmithery), 69 (cutting tools).  | IVb, IVc, IVe to IVg (various metal goods), IVk and IVl (needles), IVm to Ivo (gold, silver, copper, and bronze goods)  | VII (production of various metal goods)  |
| VI. Firearms: | 72 (firearms) | IVh (firearms) | . |
| VII. Electrical engineering (to industry IV) | 21 (electrical engineering), 74 (signals) | . | . |
| VIII. Precision mechanics | 57 (photography), 83 (horology) | . | VIIc (watchmaking) |
| IX. Scientific and medical instruments | 30 (medical instruments), 42 (instruments), 70 (writing instruments) | . | VIIa (scientific instruments), VIIb (medical instruments) |
| X. Chemicals and dyes | 12 (chemical processes), 16 (fertilizers), 22 (dyestuffs) | Ve (chemicals incl. dyes), VId (salt), IVe (tar), VIg (glue), VIk (bone mills) | IIIc and IIId (dye production),  |
| XI. Explosives | 78 (explosives and matches) | IVi (powder and ammunition), Vf (matches) | . |
| XII. Mineral oil and lipids | 23 (mineral oil and lipids) | Vg (perfume factories), Vh (mineral oil), VIh (wax), VIi (stearin) | IIIb (soap boiler) |
| XIII. Ceramic and stone working | 80 (clay, stone, chalk, cement, asphalt), 67 (grinding and polishing), 75 (sculptures) | Va to Vc (lime kilns, brick factories, asphalt factories), Vm (porcelain), Vn (stoneware)  | IVa (stonemasons), IVb (potters) |
| XIV. Glass | 32 (glass production) | Vi to Vk (glass and mirror factories) | IVc (glaciers) |
| XV. Leather | 28 (tannery), 56 (saddlery), 71 (footwear) | VIf (leather production), VIIk (leather goods)  | IIIa (tannery), XI (production of leather goods) |
| XVI. Rubber | 39 (horn, ivory, and other carved goods, rubber, gutta-percha) | VIIe (bone, ivory), VIIf (rubber, gutta-percha) | . |
| XVII. Wood processing | 38 (wood processing) | VIc (saw mills) | . |
| XVIII. Paper and printing | 11 (bookbinding), 15 (printing machines), 54 (paper processing), 55 (paper production) | VIIg (paper mills), VIIh (paper processing), VIIIi (writing ware), VIIIm (special paper)  | XIVe (bookbinders) |
| XIX. Household goods and toys | 9 (brushes), 33 (traveling equipment), 34 (household goods), 44 (haberdashery), 77 (toys) | VIIa (umbrellas), VIIb (knobs), VIIc (furniture), VIId (toys), VIIl (playing cards), VIIIn (various household goods) | XIII (wood goods for household use), XIVa-XIVd (haberdashery, brushes, and toys), XVIf (broom-maker) |
| XX. Musical instruments | 51 (musical instruments) | . | VIIc (musical instruments) |
| XXI. Flour mills | 50 (flour mills) | VIa (oil mills), VIb (bark mills), VIIIa (flour mills) | . |
| XXII. Beer, wine, and alcohol | 6 (beer, wine, and alcohol), 64 (bar equipment) | VIIIh (vinegar), VIIIi (breweries), VIIIk (liquor), VIIIl (champagne) | . |
| XXIII. Foodstuff | 2 (bakery), 17 (ice machines), 53 (foodstuff in general), 66 (meat processing), 82 (drying and kilning), 89 (sugar and starch) | VIIIb (meat), VIIIc (starch), VIIId (chocolate), VIIIf (sugar), VIIIg (juice) | I (production of food) |
| XXIV. Tobacco | 79 (tobacco) | VIIIe (tobacco) | . |
| XXV. Construction | 37 (building construction), 84 (hydraulic and foundation engineering), 85 (water supply and sewerage) | . | V (building construction) |

*Source:* Donges and Selgert (2019) online appendix.

*Notes: a* The Arabic number indicate the technology class according to the classification of the Imperial Patent Office. *b* The Roman numbers indicate the categories in the Zollverein survey, small letters indicate the sub-categories; the survey has several parts: the first part includes all craftsmen, the second part includes factory-employment, and each part uses its own numbering.

We added the categories 29 and 60, which Donges and Selgers (2016) did not assign to a class, because they had no patents in these categories.

Table A4: Assigned life span and annual patent fees by sector

|  |  |  |
| --- | --- | --- |
|     | Assigned life span | Annual patent fee |
| (1818-1868) | (1844-1868) |
| mean | sd | N | mean | sd | N |
| I. Textiles | 6.1 | 2.6 | 141.0 | 11.5 | 5.6 | 91 |
| II. Coal, coke, and gas generation | 5.8 | 2.3 | 56.0 | 10.1 | 4.9 | 35 |
| III. Metal production | 6.3 | 2.8 | 44.0 | 10.7 | 5.7 | 28 |
| IV. Machine-building | 5.8 | 2.4 | 266.0 | 10.1 | 5.2 | 194 |
| V. Metal goods | 5.8 | 2.2 | 36.0 | 7.2 | 2.6 | 18 |
| VI. Firearms | 6.4 | 2.5 | 19.0 | 10.7 | 4.5 | 7 |
| VII. Electrical Engineering | - | - | - | - | - | - |
| VIII. Precision mechanics | 6.9 | 2.7 | 25.0 | 6.7 | 2.4 | 15 |
| IX. Scientific and medical instruments | 5.7 | 2.6 | 52.0 | 7.7 | 3.6 | 31 |
| X. Chemicals | 6.6 | 2.6 | 73.0 | 11.8 | 4.5 | 42 |
| XI. Explosives | 5.9 | 2.3 | 10.0 | 12.0 | 2.7 | 5 |
| XII. Mineral oil and lipids | 5.5 | 1.6 | 20.0 | 8.5 | 3.4 | 17 |
| XIII. Ceramic and stone working | 6.7 | 2.7 | 57.0 | 8.1 | 2.7 | 33 |
| XIV. Glas | 8.3 | 2.9 | 3.0 | 15.0 | 7.1 | 2 |
| XV. Leather | 6.4 | 2.5 | 30.0 | 9.1 | 4.9 | 16 |
| XVI. Rubber | 6.5 | 4.9 | 2.0 | 17.5 | 3.5 | 2 |
| XVII. Wood processing | 6.7 | 2.6 | 31.0 | 10.2 | 5.6 | 24 |
| XVIII. Paper and printing | 6.1 | 2.4 | 69.0 | 9.9 | 5.4 | 40 |
| XIX. Household goods and toys | 5.4 | 2.1 | 55.0 | 7.2 | 3.9 | 29 |
| XX. Musical instruments | 7.1 | 2.7 | 23.0 | 8.5 | 5.5 | 13 |
| XXI. Flour mills | 6.4 | 2.4 | 31.0 | 8.1 | 3.9 | 18 |
| XXII. Beer, wine, and alcohol | 5.7 | 2.0 | 35.0 | 8.0 | 4.9 | 23 |
| XXIII. Foodstuff | 6.0 | 2.7 | 38.0 | 10.4 | 5.5 | 24 |
| XXIV. Tobacco | 6.6 | 2.7 | 11.0 | 12.1 | 5.7 | 7 |
| XXV. Construction | 5.8 | 2.6 | 13.0 | 11.7 | 6.1 | 9 |

Source: see text