European
Historical
Economics
Society

EHES WORKING PAPERS IN ECONOMIC HISTORY | NO. 133

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JUNE 2018

EHES Working Paper | No. 133|June 2018

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Gravity and Migration before Railways: Evidence from Parisian Prostitutes and Revolutionaries

Morgan Kelly* and Cormac Ó Gráda†

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Although urban growth historically depended on large inflows of migrants, little is known of the process of migration in the era before railways. Here we use detailed data for Paris on women arrested for prostitution in the 1760s, or registered as prostitutes in the 1830s and 1850s; and of men holding identity cards in the 1790s, to examine patterns of female and male migration. We supplement these with data on all women and men buried in 1833. Migration was highest from areas of high living standards, measured by literacy rates. Distance was a strong deterrent to female migration (reflecting limited employment opportunities) that falls with railways, whereas its considerably lower impact on men barely changes through the nineteenth century.
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1 Introduction

Although studies of contemporary migration focus for the most part on international flows, internal migration was pivotal to the historical development of

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Europe, and to its urbanization in particular. With deaths rates that considerably exceeded their birth rates, cities between the sixteenth and nineteenth centuries relied on large streams of migrants to fuel their rapid growth: in 1790s Paris, for instance, only thirty per cent of the population was native born. However, in the absence of reliable censuses before the mid-nineteenth century, understanding what drove migration before the coming of the railways has rarely been possible. In this paper, however, we are able to examine the dynamics of working class migration into Paris between the mid-eighteenth and mid-nineteenth centuries using information on two groups: prostitutes, and male holders of identity cards during the Revolution.[1]

From these people, who turn out to be representative of working class Parisians, we can estimate a gravity model of migration. In particular, we look at how distance and living standards affected the migration decisions of women and men, and on how their impacts changed over time.

Prostitution might seem like an unpromising avenue to understanding migration. Although prostitution has always served as a survival strategy for women in dire economic circumstances, being a morally taboo and usually illegal activity means that little is usually known about the women involved. A notable exception, however, is nineteenth century Paris where, after the Revolution it was decided that, given its inevitability, prostitution should be regulated rather than prohibited (Harsin, 1985, 57–94). As a result prostitutes were required to register with the police and undergo regular health checks. When they registered, women were required to give their age, their previous occupation, their father's occupation, and where they came from. These data, along with other information based on extensive interviews with prostitutes, were collated by Alexandre Parent-Duchâtelet, one of the pioneers of public health and social statistics, in his monumental *De la prostitution dans la ville de Paris* of 1836 which remains the most systematic study of female sex workers ever undertaken.[2]

[1]Classic sources on nineteenth-century migration to Paris are Chevalier (1950) and Rosental (1999). See also Rosental (2006).

[2]By contrast later studies, such as Ryan (1839) and Acton (1870) looking at London, are largely anecdotal; and even the ambitious Urban Institute effort to estimate the size of the US sex trade

Parent-Duchâtelet's data on the geographical origin of these women, along with further information in the 1857 revision of his book, therefore provide a potential source of information on the migration patterns of working class women both before and after the coming of the railways. These data can moreover be supplemented with information compiled by Benabou (1987) on the origins of women arrested for prostitution during the 1760s.

A natural concern, the findings of Parent-Duchâtelet notwithstanding, is that prostitutes were not a representative sample of working class Parisian women. Fortunately we also have information on the birthplace of all women buried in Paris in 1833, most of whom would have arrived there around 1800. We find that their migration patterns closely match those of the 1830s sample of prostitutes.

Turning to men, our principal source is revolutionary Paris. In late 1792 and early 1793, men were required to register for a *carte de civisme* that, alongside age, occupation and date of arrival in Paris, recorded their birthplace. We have complete lists of these identity cards for three heavily radicalized working class districts of Paris, as well as a ten per cent sample that covers most of the city. One more source for the period is information on army recruits from 1802–1810. Finally, just as for women, we have information on the birthplaces of all men buried in Paris in 1833 to serve as a check on the representativeness of the identity card records.

Distance apart, gravity models predict that migration should be driven by differences in living standards: people should move from areas of low income to those with potentially higher living standards. Naturally this prediction needs to be modified to allow for the risks of not being able to find a job after moving to a higher wage area, and problems in raising the money needed to make the journey. To measure living standards, in the absence of wage data for all the periods we analyse, we rely on more systematic records of the literacy of military recruits which tend to correlate with available wage data.

(Dank et al., 2014) is based on interviews with a fairly small number of pimps, and contains little information on the women involved. The one, notable, exception is Henderson's (1999) study of London prostitutes in the eighteenth century, based on an extensive variety of court records. We compare his findings with Parent-Duchâtelet's below.

We find that migration is strongly explained by distance and literacy levels, with marked differences between women and men. Before railways, women were considerably less mobile than men: the elasticity of their migration rate with respect to distance was in the range -2.4 to -3 whereas for men the estimated coefficient lies in the range -1.25 to -1.75. By the 1850s, after railways had appeared that connected all major cities to Paris, the gravity coefficient for women had fallen to about -2. These large differences between women and men reflect the much more limited female job opportunities in Paris as servants and seamstresses compared with the heavy demand for men in industry and construction. Among unmarried people in their twenties living in Paris in 1851, men outnumbered women two to one (Conner, 2017, Table 7.3), an imbalance that Corbin (1990) argues was a large factor driving the market for prostitution.

Moving to the end of the century, in 1891 the gravity coefficient for all Parisians (the census data do not distinguish between women and men) was only -1.25, similar to modern Europe. Although our data on Parisian prostitutes ends in the 1850s, we do have data for Marseilles in 1882, and find that the gravity coefficient for these women is similar to that of the general population (female and male) of Marseilles in 1891, suggesting that mobility differences between women and men had lessened substantially and possibly disappeared.

Turning to the impact of living standards, in every case migration from a *département* is increasing in its literacy, especially for women. Although there may have been greater relative opportunities for educated people in Paris compared with the provinces, this is unlikely to have been a factor for the mostly illiterate working class migrants in our sample, and the impact of literacy probably reflects higher living standards that made travel to Paris affordable.

The link between distance and migration was first addressed formally by Ravenstein (1885, 198–199) whose First Law of Migration stated that most migration was short-distance (and whose Seventh Law was that women migrate more than men). The seminal contribution on this topic of course was Zipf (1946) who found that inter-urban migration followed a P_1P_2/D process. Pooley and Turnbull (2005) use a sequence of life histories from the 1750s onwards to assess migration within Britain

but do not consider gravity as a determinant. For contemporary societies, Stillwell et al. (2014) estimate a gravity coefficient of -1.5 for the United Kingdom and Poot et al. (2016) find a coefficient of -0.8 for New Zealand. Dank et al. (2014) attempt to estimate the size of the underground sex economy in eight large US cities, in part by tracking the mobility of 73 pimps through a gravity model. The approach closest to our own is the innovative study of Crymble, Dennett and Hitchcock (2018) who use records of vagrants expelled from Middlesex (London, roughly) in the late eighteenth century to estimate an explicit gravity model of their origins, although their estimated gravity coefficient of -0.5 (Table A1) is puzzlingly low even by comparison with modern populations.

The rest of the paper is as follows. Sections 2 and 3 describe the data on prostitutes and identity card holders that form the basis of our study of female and male migration. In Sections 4–6 we show that the migration of these groups is well explained by a simple gravity model, as is that of people buried in Paris in 1833, and that the impact of distance on female migration falls after the appearance of railways. Section 7 concludes.

2 Female Migration: Prostitutes

We wish to understand how distance and living standards affected the composition of immigration to Paris before and just after the coming of railways: in other words to estimate a gravity model. We begin with women, looking at the migration patterns of female prostitutes from the 1760s to the 1850s. Our information comes from two classic studies. The first is Parent-Duchâtelet's 1836 analysis of women working as registered prostitutes; and the other is Benabou's (1987) study of over 2,000 women arrested for prostitution in the late 1760s.

For prisoners in the 1760s, most of whom were in their early twenties, the largest occupational groups were clothing and textile work (50 per cent), laundry work (15 per cent), petty trading (13 per cent), domestic service (13 per cent), and other artisanal occupations (5 per cent). Another analysis of occupations, this time in a section of the city located north of the Jardin des Tuileries, in the early 1790s,

reports that 40 per cent had been in the clothing trade, 10 per cent each as shop assistants or day labourers, but 22 per cent described themselves simply as prostitute or mistress (Conner, 2017, Table 7.2). Similarly, the less systematic evidence for the late eighteenth century compiled by Hufton (1974, 306–317)—who coined the term "an economy of makeshifts" to describes the survival strategies of the poor—again finds that a majority of women had been servants or seamstresses who "started and finished hungry and in rags."[3]

However, the most detailed study of prostitutes ever undertaken was by a pioneer of public health and social statistics Alexandre Parent-Duchâtelet in his 1836 *De la prostitution dans la ville de Paris*. He based his study on the registration records of prostitutes, as well as extensive interviews with women in infirmaries and prison, and frequent visits to brothels.[4] From these he was able to compile detailed statistics on the age of these women, their previous occupation, how long they had worked as prostitutes, their father's occupation, and why they had become prostitutes. Based on his interviews he gave extensive accounts of prostitutes' lives such as their pastimes, religious attitudes, romantic relationships, survival rates of their children (effectively zero); as well as detailed descriptions of the organization and clientele of the sex trade, in brothels, lodging houses, and on the streets.

Two contradictory attitudes to prostitutes collide throughout the book. Dominating almost always is the view that the innate degeneracy of these women (their childish, improvident behaviour, their idleness, drinking, gambling, and supposed propensity to lesbianism) posed a fundamental threat to the social order, a threat that could only be contained by vigorous regulation. Before studying the sex trade, Parent-Duchâtelet's best known work was on the sewers of Paris and in the Introduction to *De la prostitution*, echoing St Augustine, he explicitly draws an analogy between the two.

In tension with his view of prostitutes as social pathogens are the his empirical findings that nearly all Parisian prostitutes were young working class women, typ-

[3]Hufton also describes the common fate of women who had contracted syphilis in an era before mercury treatment and were left, almost literally, to rot in *dépôts de mendicité*.

[4]"ALWAYS ACCOMPANIED BY AN INSPECTOR" p21, original emphasis.

ically illiterate, who were driven into prostitution by dire economic circumstances.[5] For instance, after a lengthy discussion of how women became prostitutes through an aversion to work and a love of luxury, he presents a table of the reasons that they themselves gave. One quarter explained the cause as destitution, another quarter the loss of their parents or expulsion from home, and another quarter were former "kept women" who had been discarded by their lovers (or fled abusive ones), and so were in effect moving from being unregistered prostitutes to registered ones. Another 8 per cent had come to Paris with soldiers or students who had abandoned them, and six per cent were servants who had been seduced by their masters and thrown out (Section 1.10, 100). However, after briefly deploring how the low wages and precarious employment of many women left them vulnerable to a choice between prostitution and starvation, he returns at length to the theme of how women progress through disorderly lives to debauchery and finally to prostitution.

Returning to the data, most of those registering were aged between 16 and 25, with a modal age of 20, although three per cent were children aged between 10 and 15. Few women remained long in the occupation: only 43 per cent were still registered after four years, and 36 per cent after five (Section 1.9, 86–87, 89). Most were uneducated: half were unable to sign their names, and most of the others could only sign in a shaky hand that Parent-Duchâtelet interprets as a sign of limited schooling (Section 1.8, 79).

Their previous occupations fall almost entirely into two categories: two thirds had been engaged in textiles or apparel, and a quarter in some form of retailing (Section 1.7, 72–75). The scarcity of women engaged in domestic service is notable, suggesting that this offered more secure employment than other occupations. For women from the provinces, 13 per cent had fathers who were farmers, 22 per cent labourers, and almost all the rest were artisans (Section 1.4, 61).

[5]This contradiction underlies how the two major studies of Parisian prostitution in the nineteenth century discuss *De la prostitution*. Corbin (1990, 3–17) focusses exclusively on the doctrine of regulation, whereas for Harsin (1985, 96–130) Parent-Duchâtelet humanized prostitutes, ultimately seeing their only defect as "not having the courage to die of hunger."

These characteristics of prostitutes are, not surprisingly, similar to what Henderson (1999, 13–50) found for eighteenth century London, relying on court records for arrested women. Again, London prostitutes were almost exclusively women aged around twenty from the lowest levels of society who rarely endured in the trade more than five years.

Turning to the number of prostitutes, Benabou (1987, 387) thought it "not inconceivable" that there were 10–15,000, if part-time *filles faciles* were included, out of a city population of 600,000. Registered prostitutes numbered about three thousand in the 1830s and five thousand by mid-century; but the number of those who were kept women or unregistered is unknown.

One reason for entering prostitution that Parent-Duchâtelet does not mention is trafficking or coercion, possibly on the grounds that widespread destitution provided an adequate supply of women into the trade. However his concern is only with lower class prostitution, and he gives no consideration to the demimonde of *dames entretenues* and high class brothels catering to the wealthy. As the notable study of Kushner (2016) shows, it was routine, at least in the late eighteenth century which her study covers, for fourteen and fifteen year old girls to be sold by their parents to madams or individual men with the full acquiescence of the police.

Kushner's main source is the files of the *Département des femmes galantes*, a branch of the police devoted to the surveillance of courtesans as a means of gathering information on their upper class clients, as well as regulating the sector to keep it running smoothly and avoid public scandal. In her sample she finds that one quarter of the women on file had been sold as children by parents who not only received the initial sale price but also frequently sought some or most of their daughters' earnings (Kushner, 2016, 72–96).

3 Male Migration: Identity Cards 1793

While prostitutes therefore provide a potentially reliable source of information on the migration of working class women into Paris during the late eighteenth and

early nineteenth centuries, male immigration can be assessed using *cartes de civisme*. These were identity cards issued by the revolutionary government in late 1792 and early 1793, and usually recorded age, occupation, birthplace, and date of arrival in Paris. Importantly, these were issued before the Terror, making them a probably reliable sample of men: many list themselves as priests or nobles, something that would have been inadvisable a few months later.

Using a ten per cent sample (12,000 cards) of these records from 25 of the city's 40 sections, representing two-thirds of its population, Blum and Houdaille (1986) estimated that annual male migration into the capital rose from about 2,000 in mid-century to about 7,000 in 1790: a net immigration rate of 3–4 per cent, and that in 1790 immigrants accounted for 70 per cent of the population over 15, a figure that remained roughly constant through the nineteenth century (Table 7).[6] Immigrants tended to come from regions of higher literacy closer to Paris, with the few coming from largely illiterate areas being better educated than average.

We also make use of identity card data for three of the city's most radicalized sections. The first two are Place des Fédérés (now Place des Vosges) in the city's north centre, and Popincourt in its northeast (Rousseau-Vigneron 1970, Sevegrand 1970). The third is for card-holders in three sections of the Faubourg Saint-Marcel in the city's south. (Burstin 1983: 79-85, 318-9). A final data source, not drawn from identify cards, are for immigrants in four districts who were recruited into Napoleon's armies between Year IX (1800-01) and March 1814 (Bergeron, 1970, 246–247).

4 Gravity and Prostitution

We have data on the number of prostitutes in Paris from different regions for three dates. The first, from the 1760s, is the number of women arrested. For 1834 and 1854 we have numbers of registered prostitutes.

The number of prostitutes per one million population in their home *département*, along with distance measured in days' journey from Paris in the 1780s is mapped

[6]Other studies using these identity cards and other sources include Henry (1971), Courgeau (1971), Roche (1979, 10–14), Houdaille (1981; 1987), and Piette and Ratcliffe (1993).

in Figure 1. Naturally, the speed of transport links rose through time. However roads, and later railways, followed topography along much the same routes used since Roman times, so relative journey times between places stayed largely constant. Using *corvée* labour (where peasants were required to work from 10–30 days each year on road building, supplying their own tools, carts and beasts of burden), and the improved construction techniques of Pierre Trésaguet (which anticipated those of Telford and Macadam) the French road network improved rapidly. Between 1765 and 1780 the time needed to travel a given distance almost halved (Clout, 1977, 463 Figure 12.8), and Arthur Young in 1787 observed that "The roads here are stupendous works." (Gillespie, 1980, 495).

During the 1840s railways began to radiate outwards from Paris, and by 1850 all major cities were connected to it. Between 1851 and 1858 the network grew from 3,500 to 8,700 km, (and to 17,400 km in 1871, and 37,000 km in 1900). Again, railways followed the same routes as roads, with the network in 1860 closely resembling the highway network in 1780 as can be seen by comparing their respective maps in Clout (1977, 465, 469).

For the 1760s the geographical reach of Paris is already evident although the apparent cluster in Morbihan in Brittany in the north-west reflects its low population: only three of the arrested prostitutes originated there. For 1834 and 1854, the steady fall-off of numbers with distance is evident.

The relationship between prostitutes per capita and distance is graphed in Figures 2 and 3 where each the size of each dot is proportional to the population of the *département*, and logarithmic axes are used. We use distance (from the centre of each *département*) instead of days' journey to spread out the points. In every case the fall-off in numbers with distance is apparent.

We wish to estimate the determinants of migration into Paris using a gravity equation. Specifically we suppose that migration M_i to Paris from district i is

$$M_i = \frac{\alpha N_i^{\beta} S_i^{\gamma}}{D_i^{\delta}}$$

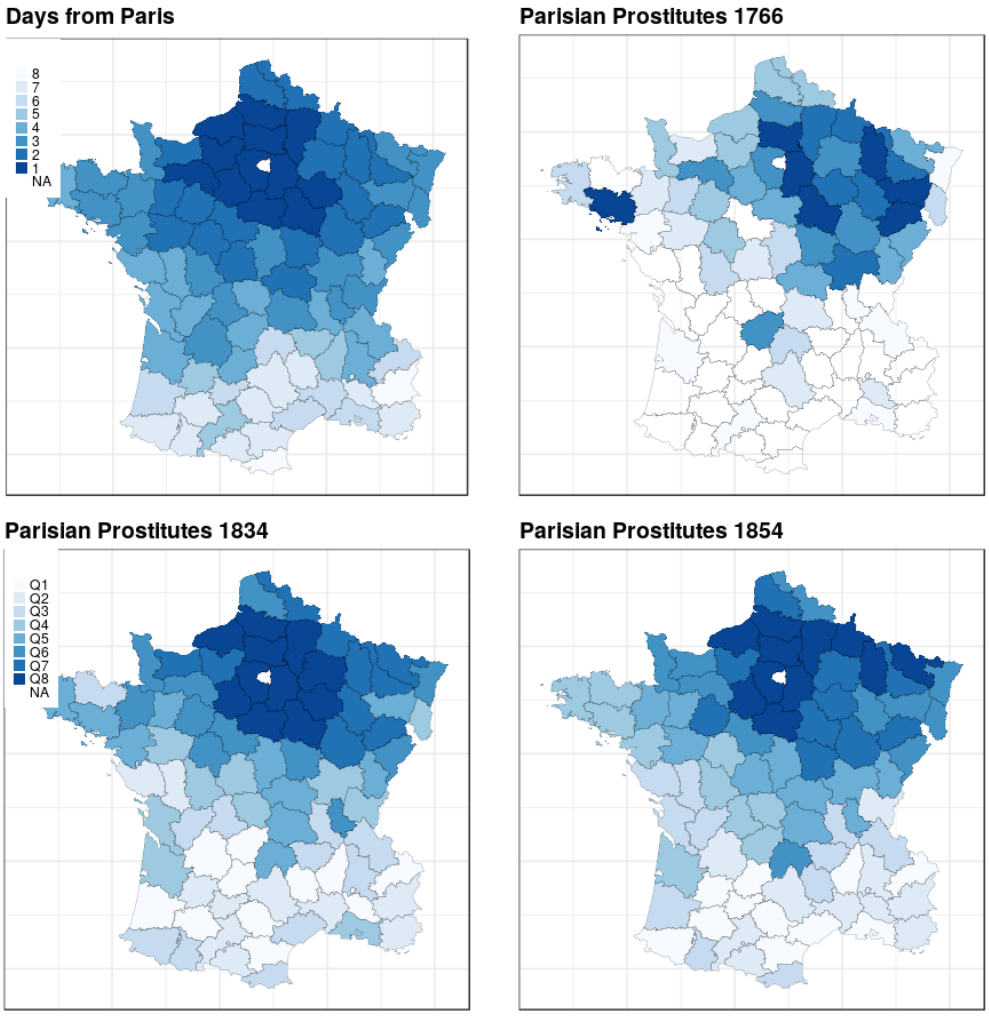

Figure 1: Distance from Paris in days in 1790; and prostitutes in Paris per capita shaded by octile.

where D_i is distance from Paris, N_i is the population of the region and S_i is a measure of its living standards. It should be noted that, in contrast to models of international trade and international migration, it is to be expected that the coefficient β on population N_i is unity. This is because arbitrary boundaries between *départements* are irrelevant to an individual's migration decision. If two neigh-

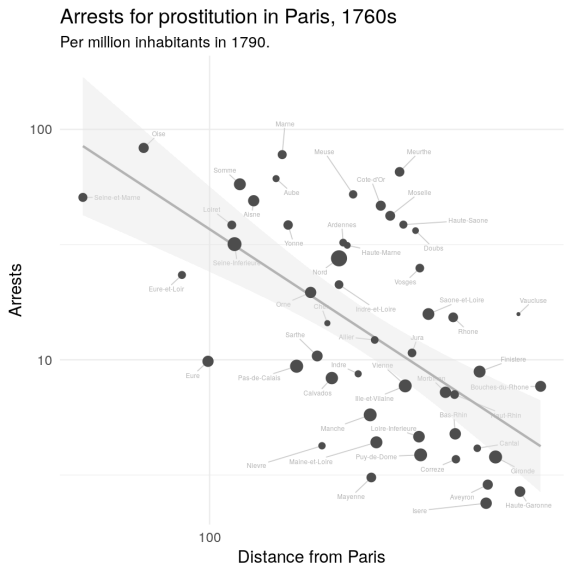

Figure 2: Arrested prostitutes relative to population versus distance from Paris, 1760s.

bouring *départements* were merged so as to double their population their migration would simply be the sum of migration from the two original *départements*.

We take logs, and use the number of migrants per million population as the dependent variable. For the 1760s there are 31 départements with no prostitutes in Paris, and one in 1834. In these cases, we apply an inverse hyperbolic sine transform (IHS) $\log\left(x+\sqrt{1+x^2}\right)$ which gives almost identical elasticities to the log transform for values above 1.

Wage data for agricultural labourers first becomes available only in 1840. We therefore use recorded literacy of army recruits as a measure of living standards S_i: the correlation between literacy in the early 1830s and wages is 0.49. Literacy varied considerably by region, ranging from 80 per cent in the northeast to only 20 per cent in some upland areas.

Table 1 shows the results of regressions using distance from Paris, in days, and literacy. It can be seen that, in every case, the explanatory power of the regressions, as we would expect from Figures 2 and 3, is high. Given the large number of zeros in the 1760s, we first report a negative binomial regression but we can see

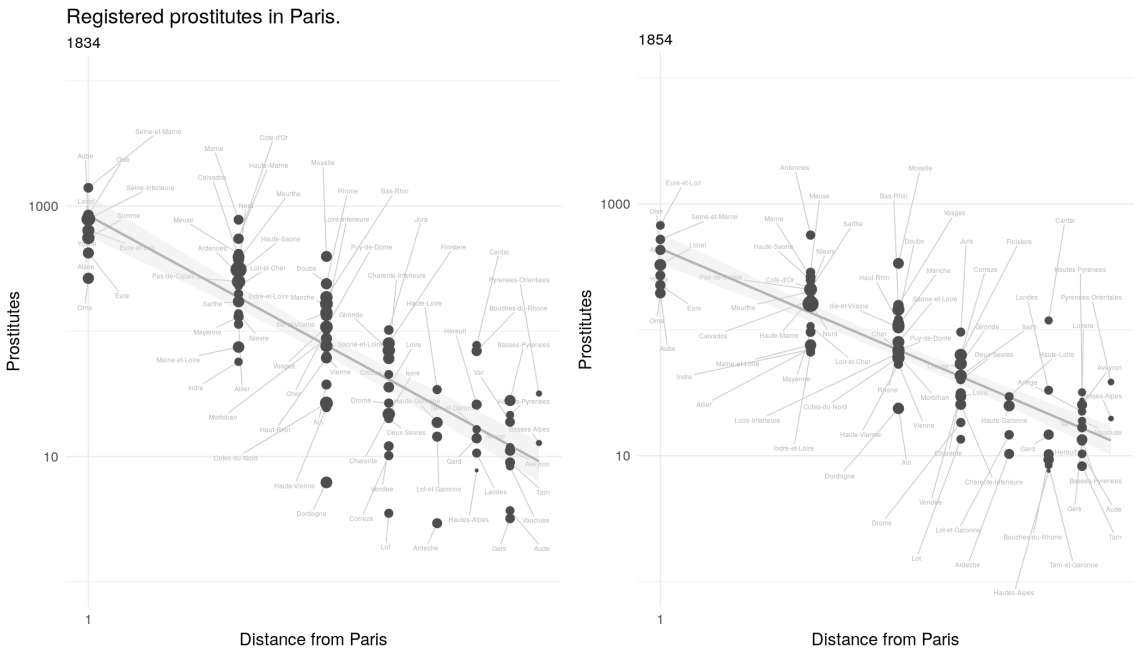

Figure 3: Registered prostitutes relative to population versus distance from Paris, 1834 and 1854.

that the results are similar to those from least squares with the IHS of the count as the dependent variable. The low coefficients on population in the 1760s regression (although in both cases the two standard error confidence intervals contain the value of one) suggests that these data may be problematic and the source of the low estimated gravity coefficient of 1.4. The effect of distance on migration δ is large for 1830s, of the order of 2, substantially by the 1850s to 1.5 (although the confidence intervals overlap), consistent with the appearance of a railway network that by 1850 connected all major cities in France. Setting the coefficient of population to unity causes the gravity coefficient to grow by around ten per cent in each regression. Also notable is the way that living standards, measured by literacy, have a substantial positive effect on migration. Given that these women, as we have seen, were almost entirely illiterate and working in menial occupations this indicates that living standards were affecting migration through the ability to afford the fare to Paris.

	1760s NB	1760s	1830s	1850s	Burials
(Intercept)	-3.986^{*}	-1.229	-5.369^{**}	-2.847^{*}	-3.682^{*}
	(1.993)	(1.714)	(1.785)	(1.380)	(1.555)
Days	-1.466^{***}	-1.408^{***}	-1.962^{***}	-1.508^{***}	-1.775^{***}
	(0.186)	(0.160)	(0.147)	(0.114)	(0.128)
Population	0.698^{*}	0.444	1.263^{***}	1.055^{***}	0.802^{***}
	(0.318)	(0.271)	(0.247)	(0.185)	(0.215)
Literate	0.732^{***}	0.514^{***}	1.064^{***}	0.568^{**}	1.235^{***}
	(0.164)	(0.129)	(0.217)	(0.168)	(0.186)
Log Likelihood	-167.858	-91.290	-91.962	-70.448	-77.604
Num. obs.	79	79	84	84	83
R^2		0.690	0.831	0.822	0.840
RMSE		0.789	0.741	0.574	0.632

All explanatory variables are in logs. 1760s NB stands for a negative binomial regression.
The female burials regression omits the large outlier of Seine-et-Oise.

Table 1: Female migration and distance.

5 Burials in 1833

A natural concern with attempts to use samples of prostitutes to reconstruct patterns of female migration is that these women may be unrepresentative of the wider female population. In particular, the greater cost of migration from distant *départements* meant that women from these places should be of higher ability than those from closer ones, and therefore less likely to find themselves destitute and having to resort to prostitution to survive. If this were the case, the number of prostitutes would under-estimate female migration from farther *départements* and so exaggerate the impact of distance.

Fortunately, we have an additional measure of migration to Paris given by the total numbers of women and men buried in Paris in 1833 (France, 1844): most would probably have arrived around 1800.

Figure 4 plots burials by distance of birth-place, excluding the *département* of Seine-et-Oise that bordered on Paris. It can be seen that for *départements* close to Paris there are roughly equal numbers of women and men, but that the number of

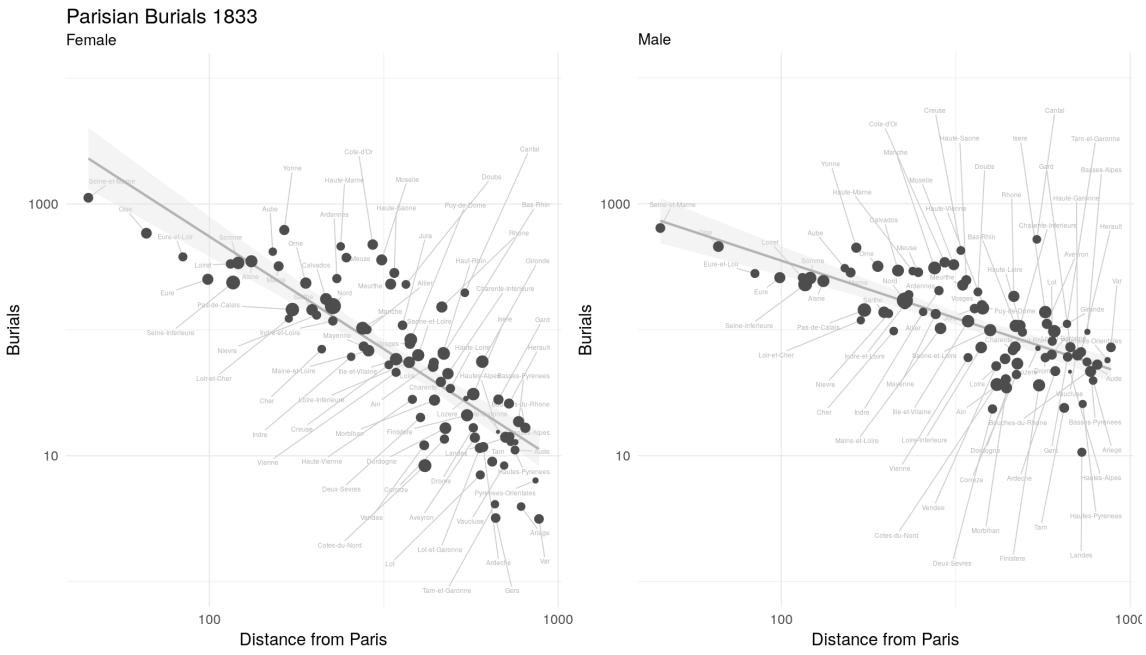

Figure 4: Burials in Paris by *département* of origin, 1833.

women falls off considerably more sharply with distance than it does for men. This is confirmed by the distance coefficients in Tables 1 and 2 where the coefficient for women is double that for men. Importantly, the results for female burials are almost identical for those for prostitutes suggesting that selection bias is not an issue for the latter. The correlation between the number of prostitutes and the number of female burials, each divided by départemental population (and excluding the three *départements* of Seine, Seine-et-Oise and Seine-Inferieure) is 0.95.

6 Revolutionary Paris

As we mentioned earlier, our major source of information on male migration comes from the identity cards issued by the revolutionary government during late 1792 and early 1793. These comprise a ten per cent sample for the entire city, and com-

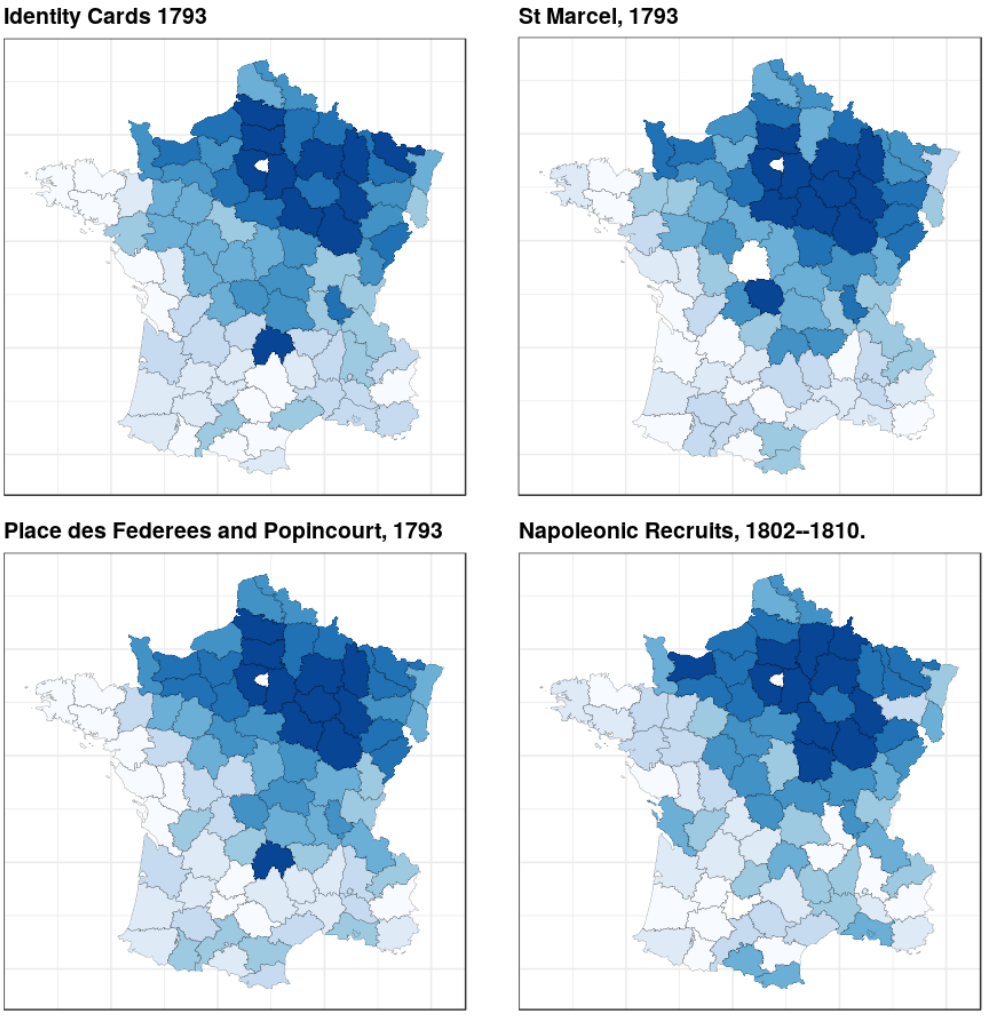

Figure 5: Birthplaces of men in Paris during the Revolutionary and Napoleonic periods, shaded by octile.

plete records for three radicalized, working-class suburbs of Place des Fédérés, Popincourt and St Marcel.

Figure 5 gives the birthplaces of these men, as well as army recruits from 1802–1810 and shows again the fall-off of migration with distance. However, there are two interesting departures from this. The first are the two darkly shaded *départements* in south-central France. These correspond to Creuse and Cantal which had a

	Radicals	Recruits	ID cards	Burials	1891
(Intercept)	3.76^{**}	-0.79	1.08	-1.28	5.63
	(1.36)	(1.60)	(1.15)	(1.02)	(4.21)
Days	-1.39^{***}	-1.23^{***}	-1.21^{***}	-0.88^{***}	-0.87^{***}
	(0.12)	(0.15)	(0.11)	(0.09)	(0.09)
Population	0.23	0.54^{*}	0.61^{**}	0.90^{***}	0.56^{***}
	(0.21)	(0.25)	(0.18)	(0.16)	(0.13)
Literate	0.48^{***}	0.47^{***}	0.38^{***}	0.42^{***}	0.35
	(0.10)	(0.12)	(0.09)	(0.08)	(0.88)
Cantal	2.69^{***}	1.29	2.37^{***}	2.25^{***}	
	(0.61)	(0.74)	(0.53)	(0.47)	
Creuse	2.11^{**}	1.37	1.47^{**}	2.02^{***}	
	(0.62)	(0.75)	(0.54)	(0.48)	
R^2	0.78	0.68	0.80	0.80	0.67
Num. obs.	78	78	79	79	81
RMSE	0.60	0.73	0.53	0.47	0.48

All variables are in logs. Robust standard errors in parentheses. Cantal and Creuse denote dummy variables for those départements.

Table 2: Male migration and distance.

long tradition of sending seasonal migrants to Paris to work on building sites and as water-carriers respectively. These patterns persisted into the twentieth century: in the 1901 census, building and restaurant workers still came disproportionately from these *départements*: Chevalier (1950, 176, Maps 23–24). The second, less marked, departure is the light shade of *départements* along the northwest coast reflecting the hostility of this region to the revolutionary government that boiled over in the Vendée uprising that began in March 1793.

Table 2 gives the results of regressions of male migrants (relative to *département* of origin) on distance from Paris and local literacy. The first column is the sum of identity card holders in Place des Fédérées, Popincourt and St Marcel; followed by Napoleonic recruits and all male identity card holders. The last two columns are for males burials in 1833, and all migrants, female and male, in 1891. Compared with women in Table 1, the impact of distance is considerably lower reflecting the

greater opportunities for male employment in manufacturing and construction.[7] Similarly, the positive impact of living standards, measured by literacy, is somewhat lower again suggesting that the cost of migration was less of an impediment for men.

Reflecting the political power of rural voters, France was interlaced with a dense network of railway lines by 1880: see Clout (1977, 469, Figure 12.12). We can judge its impact in the final column of the table, using data from the 1891 census. This does not, however, give separate results for women and men. It can be seen that the impact of gravity is somewhat lower than for men in the 1790s (excepting male burials) and overall explanatory power is a good deal lower, while the standard errors associated with literacy have increased substantially.

However, we do have one data source for female migration in the late nineteenth century: registered prostitutes in Marseilles in 1882. For these women the gravity coefficient (in terms of kilometres from Marseilles) is -1.5 compared with a coefficient of -1.86 for all migrants in 1891 (in each case the standard error is 0.2). This suggests that the impact of distance differed little between women and men by this time, and this is borne out by Sewell's (1985, Table 7.8) data for the birthplace of brides and grooms. In 1821–1822 9 per cent of women came from outside the hinterland of Marseilles compared with 19 per cent of men; in 1846–1851 the corresponding numbers were 19 per cent and 24 per cent; and by 1869 there is effectively no difference with 37 per cent of brides and 35 per cent of grooms.

6.1 Mixed Effects Estimation

The regressions in Tables 1 and 2 show consistent migration patterns for women and men, with the impact of distance being greater for women, who also show a somewhat larger positive effects of living standards in their place of origin, measured by literacy. However, carrying our repeated gravity regressions for these different groups is inefficient in that it fails to take account of the similarity be-

[7] Similarly, for eighteenth century Lyon, Garden (1970, 80) finds that 80 per cent of women migrants came from neighbouring provinces, but only two thirds of men.

tween them: knowing the coefficients of a regression for one group of women gives us a good idea of what the coefficients for another group are likely to be. It is possible therefore that the precision of estimates can be improved by pooling all the samples together and carrying out a mixed effects regression. Specifically the coefficient for each variable i (distance, literacy, or intercept) for group j (1766 prostitutes, identity card holders, and so on) represents a drawing from a normal distribution with mean $\beta_i + \beta_{ij}$ and variance σ_i^2: Bates et al. (2015).

The elasticities of migration with respect of distance and literacy across all groups are shown in Figure 6, where the line around each coefficient denotes a two standard error bar. It can be seen that gravity coefficients for women before railways is in the range -0.25 to -3, while the elasticity with respect to literacy is close to unity for women in the 1830s. Looking at prostitutes in 1854 we can see again how the impact of distance has fallen markedly relative to their counterparts in 1834. For all male groups we can see a somewhat smaller impact of literacy, with gravity coefficients for most groups around -1.5.

7 Conclusions

The rapid growth of European cities between the sixteenth and nineteenth centuries relied on large influxes of migrants, but little is known of the processes that drove this migration, of women especially. In this paper we were able to exploit data from the monumental study of Parisian prostitutes by Parent-Duchâtelet (1836), supplemented by data on arrested prostitutes in the 1760s and all female burials in 1833, to estimate the mobility patterns of ordinary women both before and after the appearance of railways. For male mobility we employed extensive data on identity card holders during the Revolution, as well as data on male burials in 1833. We found that distance was a strong impediment to female mobility, but much less so for men, whose mobility in the 1790s is not substantially less than it was a century later. Turning to the impact of living standards on mobility, we found that affluent areas supplied more migrants, with a larger effect for women than for men.

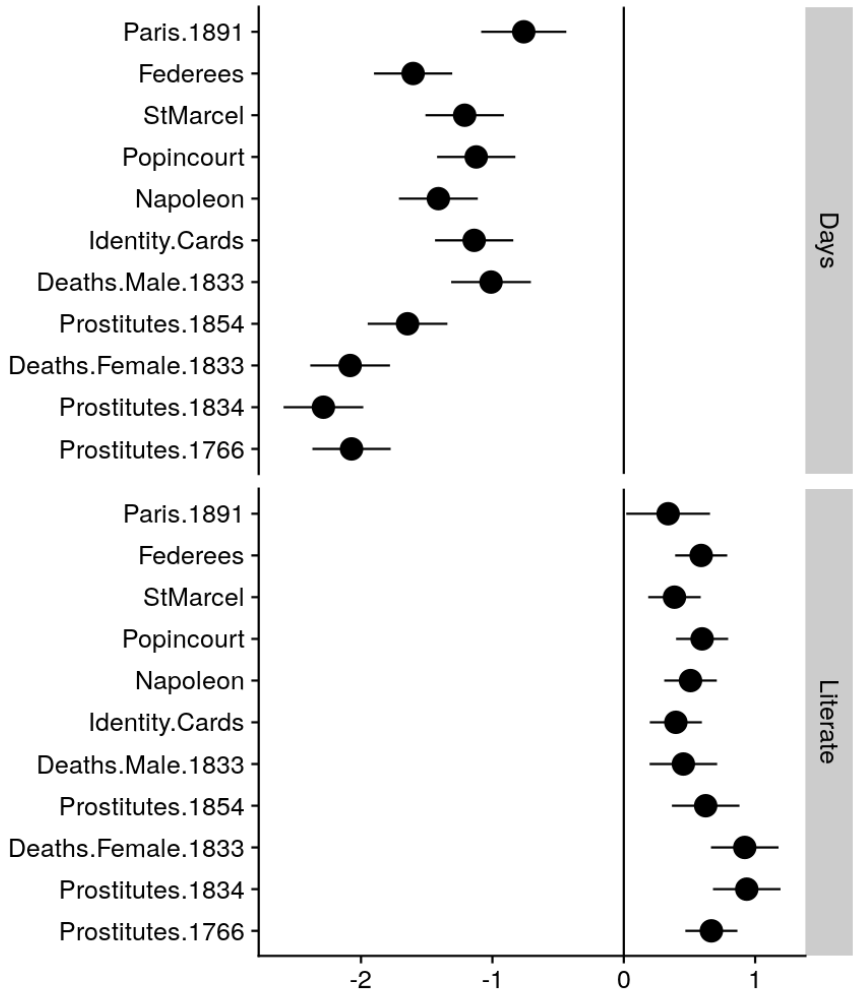

Figure 6: Estimated elasticities from a mixed effects regression of migration on distance and literacy. Lines denote two standard errors.

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