

Fertility Transition in Portugal and the Multiple Response System*

Isabel Tiago de Oliveira

isabel.oliveira@iscte.pt

The present investigation analyses the fertility decline in Portugal according to two basic perspectives: the first one, of a conceptual nature, states that this process ought to be understood in the context of a demographic system in which the components interact with each other; the second one, of a methodological nature, claims that this subject should be analyzed with suitable models in order to explain a variation that takes place, simultaneously, both in time and space.

The perspective pointing towards the mediator role played by demographic mechanisms was first suggested by Davis (1963) and further developed by Friedlander (1983, 1991, 1995, 1999). This perspective suggested two intermediate mechanisms – nuptiality restrictions and outmigration – as a means of granting populations a certain relief from the *societal strain* and therefore delaying or slowing down the decline in marital fertility. According to this perspective, the more significant outmigration and nuptiality restrictions were, the later or slower couples would start adopting contraceptive methods.

The *fertility transition* analysis based on econometric models suitable for explaining time variation, has recently started to make a stand in most literature revisions on the European fertility decline. According to this perspective, the main purpose is to explain how fertility rates changed over time and not regional differences at a given period (Galloway, Hammel and Lee, 1994 and 1998; Brown and Guinnane, 2002 and 2003). This line of thinking strongly criticize the conclusions drawn at the European Fertility Project (EFP)¹, claiming that this project has underestimated the importance

* This text was written in the context of a PhD project supervised by Professor Maria Luís Rocha Pinto, to whom I wish to express my gratitude. I would also like to thank Professor João Andrade e Silva for his great support regarding econometric issues. My gratitude goes also to Professor Dov Friedlander for having placed at my entire disposal his data on migration to England and Wales, and for his comments on this paper. My recognition and appreciation also include Javier Silvestre, who has made me feel at liberty to avail myself of his data (unpublished at the time) on migration rates in Spain. My appreciation is to Professor Livi Bacci, for his extremely useful suggestion on select bibliography, which has allowed me to get the migration rates in Italy, and Professor Reher whose corrections regarding Spain were vital to this essay, and to Professor Guinnane suggestions on this issue. I would also like to thank my colleague Sónia Cardoso for having conducted the revision of this text.

¹ In this project, that has analysed approximately 700 European regions for as long as a century, the demographic transition theory was strongly criticized. Apparently, results didn't take much into account the importance of both socio-economic factors and individual motivations; plus, the decline in infant mortality didn't seem to have been prior to that of legitimate fertility (Coale, 1973, Knodel and Van de Walle, 1979, Coale and Watkins, 1986). On the contrary, following the EFP release, most studies focused on non-socio-economic factors, emphasising the role played by peoples' attitudes, the *contraception culture*, and diffusion networks as far as the birth control adoption process was concerned. This opposition was so clear, that the expression *demographic transition* fell into disuse, thus becoming gradually replaced by the expression *fertility transition* (E. van de Walle, 1992).

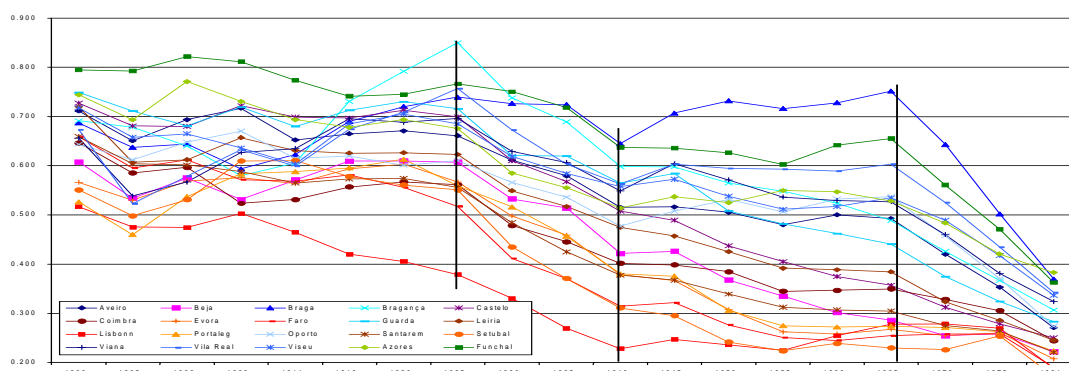
of both socio-economic factors and mortality on the European fertility decline. A significant part of the texts that do not accept the Princeton version suggests the existence of a number of methodological problems, thus raising several doubts regarding not only the indicators lack of sensitivity (Guinnane, Okun and Trussel, 1994; Weir, 1994), but also the excessive aggregation and heterogeneity of the administrative units used (Reher, 1989; and the already mentioned essays by Friedlander, Brown and Guinnane, and Galloway, Hammel and Lee), and, more recently, regarding also the various problems that arise from the use of inappropriate econometric models for time variations (Richards, 1977 and the mentioned essays by Galloway, Hammel and Lee; and Brown and Guinnane).

The study of the Portuguese *fertility transition* process, located both in time and space, can be done by two complementary perspectives. The first consists in analyzing the turning points that marked marital fertility evolution and the two mediators mechanisms – nuptiality restrictions and outmigration. The second perspective concerns the econometric modelization of both chronological development and regional diversity in this process.

Analyzing Critical Moments

The second half of the 1920s registered a significant decrease in terms of legitimate fertility rates in most Portuguese regions, thus signaling the beginning of the *fertility transition* in almost every district².

Graphic n.º 1 – Ig in Portugal between 1890 and 1981

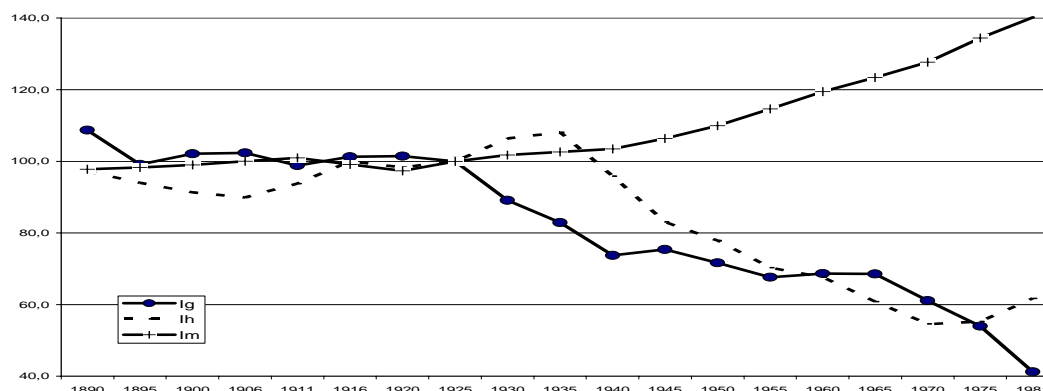


Two crucial moments can be pointed for the on set fertility decline: the second half of the 1920s, which signaled the beginning of the *first fertility transition*, and the second half of the 1960s, the decade in which the *second fertility transition* took place. Within the *first fertility transition* there were two different stages. The first one, which lasted from 1925 to 1940, signaled a significant decrease in terms of legitimate fertility, whereas the second one, which took place between 1940 and 1965, featured a certain stabilization approximately .150-.200 points below the former values.

² This process took place mainly according to two models: first, a region, which can be compared to what Orlando Ribeiro (1945) called the North Atlantic region, where the characteristics of this decline were similar to those presented by most European countries, with 3 successive and clearly delimited stages (an initial decrease, followed by a period of stability and, then again a new decreasing phase); then, a Mediterranean-like region, comprising the Northern border and Southern region where it was possible to find a somewhat more significant stability as far as the whole decreasing process was concerned, thus making it more difficult to distinguish the different stages perceived in the North Atlantic region.

Considering the second half of the 1920s as the time to the onset of the fertility decline, it is necessary to date the inflexion moments in migration and nuptiality evolution.

Graphic n.º 2 – Index numbers (period base = 1925) from Ig, Im and Ih between 1890 and 1981



Nuptiality restrictions have only begun to be less important since 1940 (Leston Bandeira, 1996 and I. Tiago de Oliveira, 2003). That is to say, that Malthus' *preventive check* would only be abandoned after the adoption of the new response. In this context, the Portuguese reality seemed to support Lesthaeghe's (1977) hypothesis B, according to which decline in marital fertility preceded the dissolution of nuptiality restrictions.

Migration³ seemed to have registered a continuous growth until the beginning of the 1920s (when marital fertility began to decline), and then experiencing a significant decrease in the decades that followed. Some years later, just before the beginning of the *second fertility transition* there is also a clear increase of outmigration. Outmigration seemed to have been carried to the extreme until before the appearance of a new demographic response (I. Tiago de Oliveira, 2003).

If compared the evolution in marital fertility with the others components of the Portuguese demographic system (mortality and illegitimate fertility), there are also two important facts that should be kept in mind:

The mortality decline seems to have preceded the fertility one, just like it had been previously suggested by the classical *demographic transition theory*. This is a somewhat limited analysis, since 19th Century data are more limited. Nevertheless, studies on mortality crisis suggest that mortality began to decrease in the second half of the 19th Century (Teresa Rodrigues, 2001 and Hermínia Barbosa, 2001).

It is not possible to find any kind of parallelism whatsoever between the evolution of fertility in and outside of marriage. On the contrary, the evolution of these two fertility types seems to reveal some contradictory tendencies: illegitimate fertility raises in most regions until 1935, date when it's started its decline. The parallelism between the two declines has no confirmation whatsoever in the Portuguese case.

Models for the Fertility Transition

³ It is not represented in the previous graphic because its variation within this period is larger so its index numbers graphic will hide other variables' variation.

Multivaried analysis based on multiple regressions became a standard practice to analyze *fertility transition* in Europe since the Princeton Project. In most of the Princeton essays, and also in many other studies carried out afterwards, the models were based on geographical cuts, performed at a given period, and they established a relationship between fertility levels and a set of explanatory variables. Still during the EFP, Richards (1977) published the first text with econometric methods for panel data: that is, for observations resulting from a cross section and a time series. This kind of methodology was later recovered by Galloway, Hammel and Lee (1994 and 1998), and also by Guinnane and Brown (2002) in their analysis on the fertility transition in Prussia and Bavaria.

These kinds of models were first described in econometric books as *Polling Cross Section with Time Series*, and they are now defined as *Panel Data*⁴. Although there are several types of econometric models that can be applicable to such data, the authors previously mentioned have always preferred to use fixed effect models. These models, also known as *Least Square Dummy Variable*, estimate a multiple regression with regional *dummies*. These *dummies* capture the mean effect of each region that the other variables in the model are not able to consider, thus diminishing the lack of specification of the models (because they didn't include aspects whose measurement is not possible). As far as *fertility transition* is concerned, these *dummies* can express, for instance, a series of aspects related to culture and regional identities.

In this investigation, the analysis units used in all models were the continent's districts and the two Portuguese archipelagoes (20 regions) and the explanatory variables used were: mortality, socio-economic change, nuptiality and migration.

In order to quantify legitimate fertility, it was used the Coale index (I_g); for mortality it was used the mortality rate⁵ (MR). As far as nuptiality was concerned, it was considered the Coale index (I_m), since indicates the female nuptiality restrictions influence on the total fertility, so is suitable for estimating the effects of nuptiality restrictions as a competitive response with the decline in marital fertility. Migration, on the other hand, was represented by net migration rate (NMR). This option is the result of the fact that net migration is a global indicator of all these in and out movements so its meaning is the same throughout the whole period. Socio-economic change was measured by a single variable drawn from a Principal Component Analysis on a series of classical indicators: male and female illiteracy rate, percentage of the population working in agriculture, in the manufacturing industry, in the transports and communications sector, in commerce and in public administration, and also the percentage of the population living in centres of 5 thousand inhabitants or over⁶.

Besides allowing the model in question to get a significant increase in terms of degrees of freedom, the use of a single variable capable of expressing these changes also allowed to reduce the multicollinearity between some explanatory variables. Plus, since the main hypothesis tested in this paper concern the

⁴ On the former designation, see for instance Kmenta (1971) or de Judge, Griffiths, Hill and Lee (1979); on the latter, see Baldagi (1995) or Wooldridge (2000).

⁵ It could have been used the infant mortality rate instead, but since higher fertility amongst couples may lead to an increase in infant mortality, the model could have endogeneity-related problems (Galloway, Hammel and Lee, 1998).

⁶ In this context, it should be mentioned that the relative weight of the population within the various occupational sectors and the percentage of the population living in centres of 5 thousand inhabitants were published by Anabela Nunes (1989 and 1989b).

importance of traditional demographic responses to the explanation fertility decline, it seemed more adequate, according to the perspective suggested by the multiple response system, to simplify the non-demographic factors.

Table 1– Principal Component Analysis of Socio-Economic Variables (1920 to 1960)

Variables:	Comp. 1	Comp. 2
Pop. in Agriculture	-.897	-.0001
Pop. in the Industry	.707	.267
Pop. in the Transports and Communications	.848	-.347
Pop. in Commerce	.967	-.003
Pop. in Administrative Services	.811	-.391
Pop. in Centres (over 5 thousand inhabitants)	.932	-.308
Male Literacy Rate	.588	.729
Female Literacy Rate	.732	.427
Explained Variation	67.1%	14.4%

The first extracted component included approximately 67% of the initial variation. This first factor places in two opposite sides: the percentage of the population working in agriculture and all the other variables (namely, literacy and urbanisation rates and the weight of the population working in other occupational sectors). This first component can be interpreted as an indicator of socio-economic change and can thus be used in econometric models on *fertility transition*.

In order to study the Portuguese *fertility transition* process, several models were estimated: distinguishable from each other by the time limits used, the specification method and the kind of purpose each one presented. In spite of these differences, there were two common aspects to all models:

1 – Considering they were explanatory (non-predictive models) the best thing to do was to compare *standardised* coefficients, since they showed the effect each variable produced in terms of standard deviation. This way (since the unit of measurement used was a *standardised* one), it was easier to compare in relative terms each factor importance.

2- Another important question regarding the analysis of these models concerned the significance tests associated for each parameter. Considering the theory was very clear on the way that each variable influenced fertility amongst couples, it was decided to use unilateral tests.

1st Model - Time Evolution (regional dummies)

The estimated model, built on panel data from the 20 Portuguese regions between 1920 and 1960, considered, on the one hand, marital fertility (lg) as dependent variable, and, on the other hand, mortality (MR), female nuptiality (Im), net migration (NMR) and socio-economic change (ACP's Fact. 1) rates as its explanatory variables. The estimated results for this model are presented in the following table.

Table 2 – Model for *fertility transition* (1920-1960) with regional *dummies*

	Coefficients	Significance ($\alpha/2$)
MR	.520	.000/2
Im	.299	.003/2
NMR	-.140	.023/2

Fact.1	-.692	.010/2
r^2_{aj}	.875	

According to this model, we can conclude that the classical *transition theory* hypothesis concerning the effects produced by mortality and socio-economic change found support on Portuguese data. There is a positive relationship between mortality and legitimate fertility(.520), that is to say a decrease of one standard deviation within the mortality rate causes a decline of about half a standard deviation within the legitimate fertility. Socio-economic change seems to be the factor with the highest influence over legitimate fertility, since an increase of one standard deviation within the socio-economic change index is associated with a decline of about 0.7 standard deviation within the marital fertility (-.692). In short, according to the most classical vision of the *demographic transition theory*, we may conclude that the two main causes present coefficients which confirm this perspective.

However, when it comes to the variables that Davis and Friedlander suggested for the existing diversity within the fertility transition, results are less encouraging. Outmigration is positively associated with the marital fertility: an increase of one standard deviation in NMR causes a decrease of 0.14 standard deviation in legitimate fertility (-.140⁷). On the other hand, nuptiality presents a positive association, when one would expect otherwise, since nuptiality restrictions are in theory associated to higher fertility levels. This is an expected relation in theory but also in practice, since in Portugal there is a negative association between Ig and Im on the chronological evolution and in the geographic patterns. Since this positive coefficient is so surprising, it was also tried a model with a nuptiality rate (for non married women), but with similar results. In short, model results are not so favourable when it comes to the *multiple response system*.

According to the *multiple response system*, the diversity in fertility transition processes is related to the importance of migration and nuptiality restrictions in different populations. Therefore, it would be necessary to use a different type modelization for panel data.

2nd Model – Regional Diversity (time dummies)

The analysis of this perspective seems to require a more adequate modelization with time *dummies*, which allow capturing the mean effects in each period and therefore allowing the variables specified in the model to explain regional diversity within the fertility transition process.

The use of a regression with time *dummies* is expected to modelize more adequately the effects produced by migration and nuptiality restrictions over the regional diversity registered during that fertility decline.

Table 3 - Model with time *dummies* (1920 to 1960)

	Coefficients	Significance ($\alpha/2$)
MR	.874	.000/2
Im	-.128	.081/2
NMR	-.201	.125/2

⁷ But the significance test associated to this variable is not so clear.

Fact.1	- .287	.010/2
T ₁₉₂₀	- .435	.018/2
T ₁₉₃₀	- .151	.330/2
T ₁₉₄₀	- .267	.101/2
T ₁₉₅₀	- .019	.866/2
r^2_{aj}	.673	

For the regional diversity within the Portuguese *fertility transition* process, mortality is the factor that causes the deepest effect, since a variation of one standard deviation in mortality causes a change of almost 0.9 standard deviation in marital fertility. Socio-economic change also has a significant effect, though in a lower scale, since a change of one standard deviation in socio-economic change causes only a change of 0.3 standard deviation in legitimate fertility⁸.

The two factors suggested by the *multiple response system* present all the expected effects. Both nuptiality and migration have a negative coefficient, which means that the highest outmigration and the most significant nuptiality restrictions are associated with lower legitimate fertility levels. Migration seem to cause a greater effect (-.201) than nuptiality restrictions (-.128). That is to say: a variation of one standard deviation either in migration or nuptiality is associated, respectively, with a change of about 0.2 and 0.1 standard deviation in legitimate fertility.

Time *dummies* variables⁹ do not seem to present any specific direction whatsoever during this period.

3rd Model – Regional Diversity only with Time Dummies

A third model was estimated for the *first fertility transition* as an alternative way of including those factors behind fertility decline according to the classical theory and the diffusion perspective. A model with time *dummies* alone, in which these *dummies* stand for the joined effect of mortality, socio-economic transformation and secularization, may also be another way of analysing this question.

Although this last specification is not so correct as the former¹⁰, it can still be used to test the hypothesis presented by the *multiple response system*, besides allowing to conduct analysis on different periods and countries, which had not been possible to perform otherwise (because there was no data available on mortality or all variables related to socio-economic changes, or/and because the number of observations wasn't enough).

If socio-economic change and mortality are, as they should, being captured from time *dummies*, then the estimated coefficients succession for time *dummies* will show a decreasing trend, since those coefficients express the period's mean effect in legitimate fertility.

The next model only specifies those variables which represent the traditional demographic growth control mechanisms, that is, nuptiality restrictions and migration.

⁸ But part of the socio-economic transformations effect can be also included in the dummies variables.

⁹ The variables (T₁₉₂₀ to T₁₉₅₀) are one for each date except one to avoid perfect multicollinearity.

¹⁰ This is obviously a rough way of operationalizing these chronological changes, since each time *dummies* takes the same value 0 or 1 for every region in each period (although it is clear that socio-economic characteristics were very different in Lisbon and Bragança). In spite of this restriction, the use of this alternative allowed to perform new analysis.

Table 4 - Model with time *dummies* alone (1920 to 1960)

	Coefficients	Significance ($\alpha/2$)
Im	-.242	.004/2
NMR	-.567	.000/2
T ₁₉₂₀	.556	.000/2
T ₁₉₃₀	.537	.000/2
T ₁₉₄₀	.392	.001/2
T ₁₉₅₀	.265	.008/2
r²_{aj}	.534	

Time *dummies* are decreasing and therefore consistent with the idea that socio-economic transformations, declining mortality and secularization have contributed to the marital fertility decline.

The factors suggested by the *multiple response system* also have the expected effect: both variables present a negative relationship with the dependent variable. A negative variation of one standard deviation in migration causes a positive change of about 0.6 standard deviation in legitimate fertility (-.567) and when that same change occurs in nuptiality, marital fertility registers a change of about .24 (-.242).

According to this model, it seems that Davis and Friedlander's hypothesis are supported by Portuguese data; furthermore, migrations are more important than nuptiality restrictions when it comes to explaining regional diversity in Portuguese fertility transition.

4th Model – Regional Diversity with quinquennial data

Since it is possible to use models for regional diversity by using time *dummies* capable of expressing the previously mentioned aspects, it was also possible to use five years demographic data¹¹). The use of estimated values to duplicate the number on available observations (can be used for two purposes: one, to confirm the results from previous analysis through the use of more accurate chronological limits, and two, to rephrase the historical continuity/discontinuity on the *fertility transition* process.

4.1. The *First Fertility Transition* (1925 to 1965)

The first purpose concerned the estimation of the same model for the *first fertility transition*, based on the time limits established by the descriptive analysis - the period between 1925 and 1965.

Table 5 - Model with quinquennial data (1925 to 1965)

	Coefficients	Significance ($\alpha/2$)
Im	-.267	.000/2
NMR	-.548	.000/2
T ₁₉₂₅	.658	.000/2
T ₁₉₃₀	.516	.000/2
T ₁₉₃₅	.500	.000/2
T ₁₉₄₀	.376	.000/2

¹¹ The inter census data are estimations. These estimations are made according to the principle that a variation in the married women in the middle of the period are proportional to the percentage of marriages that occurred in each quinquennium (I. Tiago de Oliveira, 2003).

T ₁₉₄₅	.353	.000/2
T ₁₉₅₀	.311	.001/2
T ₁₉₅₅	.145	.084/2
T ₁₉₆₀	.177	.034/2
r²_{aj}	.404	

The estimated values for nuptiality and migration are almost identical to the ones presented in the previous model with decennial data: the estimated effect caused by nuptiality restrictions changes from -.242 to -.267, and the one caused by migration changes from -.567 to -.548. As far as time *dummies* coefficients are concerned, we can see that, as it was expected, they present a decreasing trend. Now that the time limits regarding the *first fertility transition* are more accurate, the previous results are confirmed.

4.2. The Pre-Transition Period (1911 to 1925)

The second possibility presented is rephrasing the question that if *fertility transition* is marked either by continuity or discontinuity. The continuity question concerns the relationship between the old demographic control methods and the new demographic response. The purpose is to see whether these inner demographic system relationships are similar before, during and after the fertility transition process or, on the contrary, if the change on the trend of a particular demographic system component is associated with a general change within the system's structural relationships.

In order to reduce error estimations, the model refers only to the years between 1911 and 1925, since under-registrations (namely those related to births) were no longer as frequent in this period as they were before.

Table 6 - Model for the fertility pre-transition period (1911 to 1925)

	Coefficients	Significance ($\alpha/2$)
Im	- .163	.065/2
NMR	- .683	.000/2
T ₁₉₁₁	- .165	.122/2
T ₁₉₁₆	- .251	.026/2
T ₁₉₂₀	- .223	.047/2
r²_{aj}	.415	

In this model time *dummies* have a somewhat oscillating behaviour and do not seem to present any specific trend whatsoever over the years, which is alright, since the fertility decline had not yet begin. The coefficients regarding the effect caused by female nuptiality restrictions and migration are relatively similar to those found in the *first fertility transition*, though slightly smaller as far as nuptiality is concerned (-.163) and more significant when it comes to migration (-.683).

In short, the models suggest that migration seem to play a more important role, that is to say, their weight seems to be greater throughout the immediately before the onset of *fertility transition*. As far as nuptiality restrictions are concerned, the effect does not seem to be as significant. However these differences should be interpreted carefully, since this period is full of singular events (like the Portuguese Republic's revolution, the 1st World War, with very significant related short time fluctuations in emigration and nuptiality, but also in mortality caused by the pneumonic flu).

Models for Other European Countries

This kind of methodology for panel data, with period-effects specified by time *dummies*, can also be used for other European countries. This way, it is possible to evaluate the pertinence of Davis and Friedlander's suggestions on the role played by nuptiality restrictions and outmigration to the postponement of fertility decline in other countries.

Since Coale indices is available for the, approximately, 700 regions analysed under the EFP, the only thing left to do was to collect data on migration. Access to data on migrations in these specific regions and during this particular period was only possible for some European countries.

These models were based on migration data collected from different sources: the model built for Spain was based on data from Javier Silvestre (2003) and Mikelarena (1993); the one built for Italy¹² was based on data published by Golini (1974); the one built for Germany was based on data from Knodel (no date) and, finally, the model built for England and Wales was based on data from Friedlander¹³.

The methodology used this time was similar to the one used in panel data models for the Portuguese districts: time *dummies* were used and it was estimated a model for each country. The time limits defined for each country correspond to the beginning of their respective *fertility transition* period; however, data covering all the *fertility transition* was only available in some of these countries.

The following table presents the coefficients from the models, so that they can be more easily compared between themselves.

Table 7 – Standardised coefficients in the models for each country

	Im	NMR	Dummies	r ² aj.
Portugal – 1925 to 1965	-.267	-.548	Decrescent	.404
Portugal – 1920 to 1960	-.242	-.567	Decrescent	.534
Spain – 1900 to 1960	-.387	-.228	Decrescent	.604
Italy – 1900 to 1960	-.138	-.311	Decrescent	.596
Germany – 1880 to 1910 ¹⁴	-.360	-.307	Decrescent	.491
England and Wales -1880 to 1910 ¹⁵	+.164	-.093	Decrescent	.886

According to this table, we can conclude that the hypothesis suggested by Davis and Friedlander on their *multiple response system* seem to be confirmed in Portugal, Spain, Italy and Germany.

Nuptiality has a negative effect over legitimate fertility. That is to say: the heavier nuptiality restrictions, the softer seems to be the pressure towards a tight fertility control amongst married couples. Migration also has a negative effect, that is, the more considerable migration losses are, the less significant the marital fertility decline become.

Briefly, traditional demographic control methods seem to have a mediator effect over the fertility decline in each country. However, there are some important differences that are worth mention. Whilst in Portugal migrations have a clearly stronger weight than nuptiality, just like what happens in Italy (although in this country both variables

¹² Reference to these data was suggested by Livi Bacci (Florence, 2002).

¹³ Data sent by the author.

¹⁴ As far as decennial data is concerned, NMR is based only on the data from the quinquennium immediately prior to the census. In the model with quinquennial data for the same periods that do not include the regions lacking Coale Index, coefficients were estimated for the Im -.348 and for the NMR -.327, time *dummies* decrease and r²aj. is .442.

¹⁵ If the same model is estimated without the London data, results for the standardised coefficients will be: Im +.170, NMR -.049, *dummies* variables decrease and r²aj. is .886.

have a softer effect than in Portugal), in Germany nuptiality restrictions and migration produce similar effects, whereas in Spain nuptiality is the most important parameter.

Unlike these countries, England and Wales gave way to a model which presents very different results. If, on the one hand, nuptiality shows a positive effect over legitimate fertility (unlike what was hypothesised and unlike what happened in other countries), on the other hand, migration does not seem to have such a significant influence over the marital fertility decline.

Another approach to the European regional diversity during the *first fertility transition* was tried, this time based on those European countries with a distinct Hajnal's nuptiality restrictions pattern and to which data on migration was found: Austria, England and Wales, France, Germany, Italy, Norway, Portugal, Spain, Sweden and Switzerland. In this model, the base-units used to perform the analysis are the countries themselves.

Unlike the previous models emigration rates were used, since this was the indicator available in more countries – data originally presented by Woodruff (1966) and later quoted by Chesnais (1986:186)¹⁶.

Table 8 - Model for the European Countries (1880 to 1930)

	Coefficients	Significance ($\alpha/2$)
Im	-.216	.063/2
Emigration	.269	.021/2
T1880	.676	.000/2
T1890	.667	.000/2
T1900	.501	.001/2
T1911	.328	.026/2
T1920	.130	.350/2
r_{aj}^2	.467	

In this model based on 10 European countries results support the previously presented hypothesis. Female nuptiality has a negative effect over legitimate fertility. That is stronger female nuptiality restrictions tend to soften the pressure towards the adoption of contraceptive methods by families. Emigration, on the other hand, has a positive effect over the legitimate fertility indicator, which leads us to think that the more people emigrate, the less resident population adhere to birth control. Time *dummies* just like what happened in the previous models present a clear decreasing trend.

Conclusion

The attempt to modelize *fertility transition* in Portugal with econometric models seems to be in agreement with the hypothesis. The model on chronological variation confirmed the role played by the factors pointed out by the *transition theory*: socio-economic change and mortality. The factors suggested by the *multiple response system*, on the other hand, present a less favourable situation.

The idea that the multiple response system aims to explain the multiple's ways that accounted for the diversity in fertility declines, rather than the change over the years, pointed out other possible econometric modelization forms. In this case, the analysis

¹⁶ Data on emigration rates was available for the following countries and dates: Austria 1880-1910, England and Wales 1861-1931, France – 1860-1930, Germany 1871-1910, Italy 1871-1936, Norway 1890-1930, Portugal 1864-1940, Spain 1890-1940, Sweden 1880-1920, Switzerland 1870-1930.

made on the previously collected data was performed according to two different methods with *dummies* variables for each period.

The estimates drawn from these models supported the hypothesis suggested by Davis and Friedlander. In the Portuguese case, migration influences the fertility decline in a much more significant way than nuptiality restrictions.

The use of models in which only the *multiple response system* related variables are clearly specified, allowed conducting several other analysis on different periods and regions.

That is how a model estimated for the pre-transition period in Portugal also underlines the weight of both nuptiality and migration, whose relationships with marital fertility seem to be somewhat similar before the on set of the *fertility transition* and during this process.

Models for panel data with time *dummies* were applied to other countries and the results have also underlined how important nuptiality restrictions and migration are to the regional diversity registered during the Spanish, Italian and German fertility transition processes (but not in England and Wales). The model that was used to estimate data from 10 European countries with Hajnal's nuptiality pattern also seems to support the importance of these two traditional demographic control mechanisms suggested by Davis and Friedlander.

References

- Anderson, M. e Morse, D., 1993. "High Fertility, High Emigration, Low Nuptiality: Adjustment Process in Scotland's Demographic Experience, 1861-1914 part II", in *Population Studies*, 47 : 319-343.
- Anderson, M. e Morse, D., 1993. "High Fertility, High Emigration, Low Nuptiality: Adjustment Process in Scotland's Demographic Experience, 1861-1914 part I", in *Population Studies*, 47 : 5-25.
- Anderson, Michael, 1998 – "Fertility decline in Scotland, England and Wales, and Ireland: Comparissons from the 1991 Census Fertility", *Population Studies*, vol. 52, pp1-20
- Baldagi, 1995 – *Econometric Analysis of Panel Data*, John Wiley and Sons, New York.
- Bideau, A. , 1983 – "Les mecanismes autorégulateurs des population traditionnelles", *Annales E.S.C.*, XXXVIII, 1040-1057.
- Brown, J. e Guinnane, T. 2003 – "Two statistical problems in the Princeton project on the European fertility transition", working paper n.º 869 de Economic Growth Center, Yale University
- Brown, J. e Guinnane, T., 2002 – "Fertility transition in a rural, catholic population: Bavaria 1880-1910", in *Population Studies*, 56:35-49
- Carlsson, C., 1966. "The Decline of Fertility: innovation or adjustment process" in *Population Studies*, 20 (2) :149-174.
- Chesnais, Jean-Claude, 1986. *La Transition Démographique. Étapes, Formes, Implications Économiques. Étude de Séries Temporelles (1720-1984) relatives à 67 Pays*, Paris, Presses Universitaires de France / Institut National d'Études Démographiques (col. Travaux et Documents, cahiers nº 113).
- Cleland, J., 2001. "The effects of improved survival on fertility" in *Population and Development Review*, 29 (suppl. 60-92).
- Coale, Ansley e Watkins, Susan, 1986. *The Decline of Fertility in Europe*, Princeton University Press, Princeton.

- Coale, Ansley J., 1973. "The demographic transition", Proceedings of the IUSSP Conference, Liège : 177-211.
- Davis, Kingsley, 1945 "The world demographic transition", The Annals of the American Academy of Political and Social Sciences, vol. 273, Jan I : 1-11.
- Davis, Kingsley, 1963. "The theory of change and response in modern demographic history" Population Index 29 (4) Oct : 345-352.
- Dupaquier, ., 1972. "De l'animal à l'homme: le mécanisme autorégulateur des populations traditionnelles", Revue de l'Institut de Sociologie, 2: 177-211.
- Friedlander, D. e Okun, B., 1995. "Pretransition Marital Fertility Variation Over Time: Was There Deliberate Control In England" in Journal of Family History, 20 (2) :139-158.
- Friedlander, D. e Okun, B., e Segal S. 1999. "The demographic transition them an d now: Processes, perspectives and analyses. Journal of Family History, 24 (4); 493-533.
- Friedlander, D. e Okun, Barbara, 1996 – "fertility Transition in Englan and Wales: continuity and change" , Health Transition Review, supplement, 6: 1-18.
- Friedlander, D., Schellekens, J. e Ben- Moshe, E. 1991. "The Transition from High to Low Marital Fertility: Cultural or Socioeconomics Determinants" In Economic Development and Cultural Change, 39 (2): 331-351.
- Friedlander, D., 1983. "Demographic responses and socioeconomic structure: populations process in England and Wales in the nineteen century", Demography, 20 (3): 249-272.
- Friedlander, Dov, 1969 – Demographic responses and Population Change, vol. N.º4 359-381
- Galloway, P. Hammel, E. e Lee, R., 1994. "Fertility Decline in Prussia, 1875-1910: a Pooled Cross-Section Time Series Analysis", in Population Studies, 48:135-158
- Galloway, P. Hammel, E. e Lee, R., 1998. "Infant mortality and fertility transition: macro evidence from Europe and new findings from Prussia", in From Death to Birth: Mortality Decline and Reproductive Change, pp.182-226
- Gillis, J., Tilly, L., Levine, D. 1992. The European Experience of Declining Fertility, 1850-1970. The Quiet Revolution, Blackell.
- Golini, Antonio, 1974 – Distribuzione della popolazione, migrazioni interne e urbanizzazione in Itália, Ed. Da Università dei Roma.
- Greenhalgh, Susan, 1995. "Anthropology Theorizes Reproduction: Integrating Practice, Political-economic and Feminist Perspectives" in Situating Fertility and Demographic Inquiry
- Guinnane, T. e Brown, J. 2003 – "Two statistical problems in the Princeton project on the European fertility transition", working paper n.º 869 de Economic Growth Center, Yale University
- Guinnane, T. e Brown, J. 2002 – "Fertility transition in a rural, catholic population: Bavaria 1880-1910", in Population Studies, 56:35-49
- Guinnane, T., Okun, B. e Trussel, J., 1994. "What Do We Know About the Timing of Fertility Transitions in Europe" in Demography, 31 (1) : 1-20.
- Hajnal, J., 1965. "European Marriage Patterns in Perspective" in Population in History: Essays in Historical Demography, ed, D.V. Glass and D.E.C. Everssley, pp 101-143, Londres
- Hajnal, J., 1982 – "Two kins of Preindustrial Household Formation System", in Population and Development Review, VIII/3, pp449-494
- Judge, G., Griffiths, W., Hill R.C., e Lee T-C., 1979 – *The Theory and Practice Of Econometrics*, John Wiley and Sons, New York.
- Kirk, D., 1996. "Demographic Transition Theory" in Population Studies, 50 : 361:387.
- Kmenta, Jan, 1971 – *Elements of Econometrics*, Macmillan Publishing Company, New York.

- Knodel, J. e van de Walle, E., 1986. (original de 1979) "Lessons from the Past: Policy Implications of historical Fertility Studies" in *The Decline of Fertility in Europe*, Princeton University Press, Princeton.
- Knodel, John E. *The Decline of Fertility in Germany, 1871-1939*. Princeton University Press, 1974.
- Knodel, no date – data on *European Fertility Project*, Office of Population Research site
- Lesthaeghe, Ron, 1980 – "On the social control of human reproduction", *Population and Development Review*, VI (4), 527-548.
- MacLaren, A., 1990. (trad. Port. de 1997) *História da Contraceção*, Terramar, Lisboa.
- Mikelarena, F., 1993- "Los movimientos migratorios nterprovinciales en España entre 1877 y 1930: áreas de atracción, áreas de expulsión, periodización cronológica y cuencas migratorias", *Cuadernos ragoneses de Economía*, 3, 2: 213-240.
- Notestein, F.W., 1945. "Population the long view", E. Schultz ed., *Food for the World*, University of Chicago Press: 36-56.
- Notestein, F.W., 1953. "The economics of population and food supplies. Economic problems of population change", *Proceeding of the 8th International Conference of Agricultural Economists*, Londres.
- Reher, D. e Iriso-Npal, P. 1989. "Marital fertility and its Determinants in Rural and in Urban Spain, 1887-1930" in *Population Studies*, 43 : 405-427.
- Reher, David, 1999 – "Back to basics: mortality and fertility interactions during demographic transition", *Continuity and Change*, 14 (1): 9-31
- Reher, David, 2004 – "The Demographic Transition Revisited as a Global Process", in *Population, Space and Place* 10: 19-41
- Richards, T., 1977. "Fertility Decline in Germany: an Econometric Appraisal" in *Population Studies*, 31: 537-553.
- Silvestre, Javier, 2003 - *Migraciones interiores y mercado de Trabajo en España, 1877-1936*, dissertação de doutoramento apresentada na Universidade de Zaragoza, 2003
- Van de Walle, E., 1992. "Fertility Transition, Conscious Choice and Numeracy" in *Demography*, 29 (4): 487-502.
- Wolldridge, Jeffrey, 2000 – *Introductory Econometrics: A Modern Approach*, South-Western College Publishing, Thomson Learning.
- Weir, David, 1994 – "New estimates of nuptiality and marital fertility fertility in France, 1740-1911", *Population Studies*, vol 48, pp307-331.
- Zelinsky, Wilbur, 1971. "The hypothesis of mobility transition", *Geographical Review*, nº61, New York : 219-249.

References (Portuguese demography)

- Bacci, Massimo Livi, 1971. *A Century of Portuguese Fertility*, Princeton university Press, Princeton.
- Bandeira, Mario Leston, 1996. *Demografia e modernidade. Família e transição demográfica em Portugal*, Imprensa Nacional Casa da Moeda, Lisboa
- Evangelista, J., 1971. *Um século de População Portuguesa 1864-1960*, Instituto Nacional de Estatística, Lisboa.
- Nazareth, J. Manuel, 1977. "Análise regional do declínio da fecundidade da população portuguesa", *Análise Social*, nº23(52) : 901-986.
- Nazareth, J. Manuel, 1977. "As inter-relações entre família e emigração em Portugal: um estudo exploratório", *Economia e Sociologia*, 23: 31-48.
- Nunes, Ana Bela, 1989 - *População Activa e Actividade Económica em Portugal dos Finais do Século XIX à Actualidade*, Dissertação de Doutoramento apresentada no ISE-UTL.

- Nunes, Ana Bela, 1989 – *A Rede Urbana Portuguesa e o Moderno Crescimento Económico*, Provas complementares de Doutoramento, ISE-UTL.
- Ramos, Rui, 1988 – “Culturas da alfabetização e culturas do analfabetismo em Portugal: Uma introdução à história da Alfabetização no Portugal contemporâneo”, in *Análise Social*, vol. XXIV (103-104), 1988 (4-5), pp1067-1145.
- Oliveira, Isabel Tiago de, 2003. *O Declínio da Fecundidade em Portugal: o Sistema de Respostas Múltiplas*, dissertação de Doutoramento apresentada na Faculdade de Ciências Sociais e Humanas da UNL.
- Ribeiro, Orlando, 1945. *Portugal o Mediterrâneo e o Atlântico*, Sá da Costa, Lisboa.
- Rodrigues, Teresa, 2001. “Detecção e Análise dos Períodos de Sobremortalidade em Portugal (séculos XVI a XIX) – o ponto da situação”, *comunicação apresentada no VI Congresso de lá Associaçion de Demografia Histórica (ADEH)*.
- Barbosa, M^o Hermínia, 2001. *Crises de Mortalidade em Portugal*, desde meados do século XVI até ao início do século XX, in *Cadernos do NEPS*, Guimarães.