Mediterranean Labour-Market Integration: Maltese Real Wages in a Regional Context, 1836-1913*

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ABSTRACT. Was there an integrated Mediterranean labour market during the nineteenth and early-twentieth centuries? In this paper, a real-wage series for Malta, the first of its kind, is constructed and analyzed alongside other real-wage series to test the market integration hypothesis. Principle component analysis shows that the region was split into at least three labour markets. Further investigation of these markets through an empirical model shows that common forces affected both markets and that there was some tendency to wage convergence.

Introduction

THERE IS A TENDENCY for labour markets to integrate as economies develop. As transport costs decrease, information flows more freely, institutional or political barriers are broken down, and migration increases. Migration has the effect of integrating geographically-distant labour markets.

However, as Boyer and Hatton (1994) argue, analyzing migration alone will tell us little about labour-market integration. It is possible for markets to be integrated with little migration or be very integrated without much migration. This is why real wages are a better measure. The logic of the law of one price holds that, in an integrated market,

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sellers will flock to the same, highest price. The price of labour is a wage. Labourers have no interest in out-pricing themselves from their market by charging too high a wage rate. A perfectly integrated market is one where wage rates are equal. The degree of variation in wages is thus often used as a measure of integration.

In this paper, a real-wage series is constructed for Malta, a central island state, at the time a British colony, and is analysed along with other Mediterranean real-wage series to examine labour-market integration in the region between 1836 and 1913. There is surprisingly little systematic and quantitative work done on this topic. To my knowledge, the best example is Williamson and Pamuk's (2000) edited volume on the Mediterranean's response to globalization before 1950, but this book leaves a lot of questions unanswered. I extend their work by tackling the following questions, put forward by Williamson (2000) himself.

1. During the labour-market integration of the Atlantic economy, what was the extent of Mediterranean integration?
2. Can the levels of Mediterranean integration be explained by different economic shocks or by the absence of migration?

The rest of the paper is divided as follows: the next section sets the historical context and surveys the literature on Mediterranean labour markets during the period. Following this, the data and sources used to construct the real-wage dataset are described. Next is the two-step empirical process. Firstly, principle component analysis (PCA) is used to identify integrated sub-regions. Secondly, the empirical model in Boyer and Hatton is used (1994) to further investigate these sub-regions. The paper ends with a conclusion and proposals for future research.

2. Historical Background

THE MEDITERRANEAN MOVED from being the world's core during antiquity to being the European periphery during the modern era. As Bateman (2010, p. 2) put it, there was '*... a shift in the axis of economic*

fortune to 'North Western Europe' from the Mediterranean. Further to this point, Williamson's (2000) summary of various data shows that there is no evidence of real wage-growth within the region between 1775 and 1875. Though not providing figures, Williamson also states that the correlation between, for example, Italian and Turkish wages, is sporadic for the same period. This indicates a lack of labour-market integration. This result makes us wonder why we should even expect to see labour market integration in a region as diverse as the Mediterranean. Some literature and preliminary data help.

Pamuk (2005) covers the very long run of Mediterranean real wages: 1100-2000. He identifies in particular the Black Death and the Industrial Revolution as two events that significantly changed the course of real wages. The Black Death was so devastatingly successful at wiping out populations that labour become scarce and hence wages rose by as much as 100% (p. 215). Clearly, population dynamics affect real wages. In the period and sample under analysis in this paper, there were no major pandemics, but what was population growth like? Maddison's (2006) data show growth rates for Italy, Spain and Turkey were all about 0.5% and 0.6% per annum between 1870 and 1913. Growth in Malta was around 0.6% between 1851 and 1881, according to the blue books. Those in Eastern Europe and Egypt, however, were closer to 1.2%. With the exception of Turkey, this fits with Foreman-Pecks' (2009, p. 10) characterization of Western Europe as 'low pressure society' (low birth and death rates) and Eastern Europe as the opposite. Downward demographic pressures on wages were, therefore, lower among the former group compared to the latter. Despite these demographic differences, however, wages in these locations began to co-vary during the late-nineteenth century (Williamson 1998, pp. 38-40). This was in all likelihood due to migration, which integrates markets. If we take Maltese migration around the Mediterranean as an example, then migratory flows were high, even in the face of growing populations in receiving countries. During the 1880s, some 15,000 Maltese emigrated to Algeria, 11,000

to Tunisia, and 7,000 to Egypt. That makes up some 20% of the Maltese population (Calleja, 1969).

Industrialization may explain why migration flew in the face of growing populations. Industrialization came late to the Mediterranean, which meant that between, 1875 and 1890, Turkey and Egypt enjoyed a real-wage growth that was faster than that of Germany and France, attracting, among others, Maltese immigrants. Italian real wages were growing slightly faster than Britain's. Spanish real-wage growth, however, slowed down while Serbia's was very modest. In the period leading up to World War I, real-wage growth collapsed in Egypt and Turkey, but speeded up in Spain and Italy. The reasons for these varying performances were also to be found in markets much farther afield. The late nineteenth century was, after all, the era of the first globalization.

The fast-growing and integrating Atlantic economy seemed to be proceeding in a different vein to that of the Mediterranean. Williamson (2000) writes that mass migration pushed real-wage convergence along in the Atlantic economy. It explained some 70% of the real-wage convergence in the late-nineteenth-century Atlantic economy (Taylor and Williamson, 1997; O'Rourke and Williamson, 1999, Ch. 8). Conversely, the almost total absence of mass migration from the eastern Mediterranean and the scant migration from the western Mediterranean meant the region's real wages were relegated to peripheral status. This is also true of the Mediterranean vis-à-vis its Northern European neighbours. Pamuk (2005, p. 224), for example, writes that '*real wage differences between the eastern Mediterranean and western Europe continued to widen during the nineteenth century and until 1950.*' This much we now know, but what about the Mediterranean labour market itself?

Research on the Mediterranean has so far only analyzed the region in relation to the global economy. This provides valuable insights, but it also obscures what was happening within the Mediterranean itself. Indeed, should we even be thinking of the Mediterranean as a single unit?

There is evidence that shows intra-Mediterranean migration was high.

Remaining with the Maltese example, Malta sent a number of immigrants to work on the Suez Canal in Egypt throughout its construction. When Malta was constructing its dockyards in 1905, the demand for labour was so high that workers from Spain and Italy were brought in (Attard 1983). We would expect this sort of migration to lead to regional labour-market integration, even though the region was failing to converge on the wider Atlantic economy.

These migrations also highlight two inadequacies regarding the literature published on the subject. Firstly, important locations such as Malta, which was at the centre of trade and migratory movements, have been ignored. While there are many more locations to consider, it is hoped that the construction of a Maltese real-wage series will fill at least some of the gap. Secondly, these movements also highlight the need for an in-depth study of the Mediterranean to understand what was going on in its own labour markets. It is only after doing this that it can really be understood why the Mediterranean economy failed to integrate with the broader Atlantic economy.

3. Data

THE SAMPLE IS DICTATED, first and foremost, by data availability, and secondly by the need for a geographical spread across the region. The sample includes real-wage series for Malta, Milan, Florence, Sarajevo, Istanbul, Alexandria and Madrid. There are a number of holes in the sample. As yet, no one has produced real-wage series for this period for Greece, the south of France, and the coast of North Africa, with the exception of Egypt. Series for these countries will prove to be invaluable, but for now what is available must suffice. Table 1 below summarises the available series, apart from Malta, the construction of which is detailed later.

Pamuk's data is drawn from a variety of locations around Turkey, and is mainly for skilled industrial workers. Allen's data is specifically for the cities listed and the wages paid to skilled builders or craftsmen. The

Table 1. Mediterranean Real-Wage Sample

Location	Skilled/Unskilled	Start year	End year	N	Source
Milan	Skilled	1836	1913	78	Allen
Florence	Skilled	1860	1913	54	Allen
Alexandria	Unskilled	1858	1913	56	Williamson
Istanbul	Skilled	1854	1914	61	Pamuk
Sarajevo	Unskilled	1862	1914	53	Williamson
Malta	Skilled	1836	1914	79	Own
Madrid	Skilled	1836	1913	78	Allen

Notes:
1. Allen refers to Allen (2001);
2. Williamson refers to Williamson (2000); Pamuk refers to Pamuk (1995).

Serbian data presented in Williamson is for unskilled building labourers, mainly from Sarajevo. His data for Egypt is drawn mainly from sources in Alexandria, and is for unskilled agricultural labourers.

The smallest number of observations dealt with in the analysis is 53, which is still a sample size reliable enough for principle component analysis or regression modelling. The other series offer a greater number of observations. The series were all deflated using geographically-specific cost-of-living indices, and so value and growth in wages are compared across space and time. This is particularly important for a region like the Mediterranean, which despite being a relatively small region in a global context, displays considerable variance in diets and living standards. More details on the construction of the wage and price indices can be found in the appendices of Williamson (2000) and Allen (2001).

While Williamson (2000) compares both skilled and unskilled wages, as the correlation between them is usually high, there is a problem here in that the real-wage series for Egypt and Serbia are for unskilled labourers, while all the other series are for skilled labourers. The law of one price holds that the price (wage) for the *same* goods (labour skill) will converge in an integrated market. The results in this paper can, therefore, be affected by changes in the ratio between the wages for skilled and unskilled labourers, due to changes in the relative demand for those categories. In times of industrialization, the demand for, and

hence wages of, Egyptian agricultural labourers would decline compared to the demand for and wages of skilled craftsmen elsewhere in the region. This in itself, however, indicates an integrated labour market, as the same demand forces are common to both markets. To put it technically, both a (significant) positive *and* negative correlation can indicate integration. It is the strength of association that matters, not its direction. O'Rourke (1994, p. 140) puts it more eloquently:

> *It is possible to view international labour-market integration in two ways: it can lead to wages in different countries co-varying over time, and it can lead to wage levels in different countries gradually converging over a number of years.*

If, on the other hand, markets were not integrated, they would operate in isolation, and wage movements in one would have no connection with wage movements in the other. The correlation would be close to zero. A reason for that result might be, for example, localised relative demand forces: relative demand for skilled and unskilled labour differed from one location to another. However, Van Zanden (2009, p. 128) writes that the skill premium – the difference in real-wage levels of skilled and unskilled labourers – was very low in western and central Europe as well as in Valencia and Naples. This indicates that relative demand *within* locations did not vary much *between* locations and was stable over the period under review.

The above issues are related to this paper's second research issue regarding whether integration can be explained by common economic forces. This is what is explored in the PCA, which is a method capable of highlighting common underlying structures among different data series. Exploring further, the regression models used include a parameter that tests for common shocks between markets.

3.1. Maltese Real Wages

FOLLOWING THE METHOD USED and explained clearly in Studer (2008), a real-wage series for Malta has been constructed, using data from the

colonial blue books, which record annually daily wage rates for 'trades'. The category refers to skilled labour, such as those employed in crafts such as carpentry, masonry and, for example, metalwork. The blue books quote a minimum and maximum wage rate, so the average of the two has been taken. The books also state that labourers worked for six days a week, except when there were religious feast days.

To deflate the wages, a Laspeyres price index has been used with a 1900 base-year, which is the base year used to construct the other real-wage series in the sample. Retail prices for some of the most important items are provided annually in the blue books. A series has been derived for this paper, using one specified for a dockyard fitter and his family in a Royal Commission (1938) report on dietary standards in Malta. Allen *et al.* (2011) use a similar approach to construct a basket for Japan and China, where goods and quantities were "suggested" by a national survey conducted beyond the period under study. The report specified the goods, their quantities, prices and share of expenditure of a dockyard fitter's wage. The series covers the fitter's wife and four children, who all lived together in an urban dwelling. Muscat (1915) gives figures from the 1901 Malta census, showing that there were on average 4.96 people per household. Although slightly higher than the average household, the basket for six used here is, therefore, still within range. The series used is seen in Table 2.

This series is the result of keeping the weights – expenditure on goods as a share of the wage – of the basket in the Report constant. Prices for certain items, for example 'sundry', were too vague for appropriate prices to be found in the blue books. Prices for other items, for example charcoal or boots and shoes, were simply unavailable in the books. When appropriate, a proportionate share of expenditure has been attributed to a similar item, for example, with charcoal and paraffin. The general weighting, however, remains the same. That is, the share of his wage that, according to the report, this labourer spent on foodstuffs or rent was mirrored in this paper.

Table 2. Consumer Price Index: Basket of Goods and its Prices in 1900.

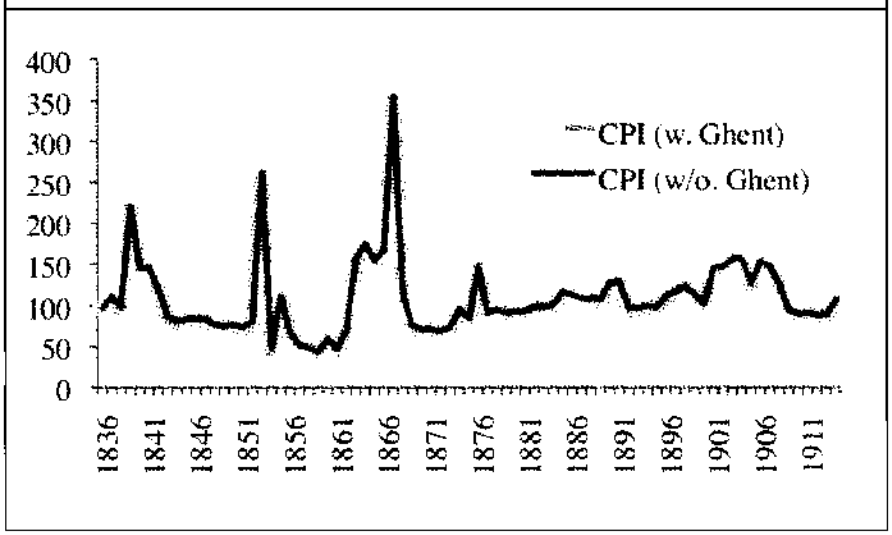
	Weekly quantity		Price in d per unit	Annual expenditure in £	Annual expenditure share in %	Annual wage share in %
Bread (wheaten)	12.056	Lb	18.08	3.92	12.90	9.72%
Butter	0.073	Lb	1.03	0.22	0.74	0.56%
Coffee	0.539	Lb	3.10	0.67	2.21	1.67%
Eggs	7.440	Units	3.10	0.67	2.21	1.67%
Meat (beef)	3.006	lb	20.67	4.48	14.75	11.11%
Milk	0.709	Gallons	12.40	2.69	8.85	6.67%
Rice	6.200	Lb	7.75	1.68	5.53	4.17%
Potatoes	7.870	Lb	7.23	1.57	5.16	3.89%
Sugar	1.378	Lb	2.07	0.45	1.47	1.11%
Tea	0.986	Lb	10.85	2.35	7.74	5.83%
Wine	1.722	Gallons	20.67	4.48	14.75	11.11%
Rents and Repairs	1.000	Unit	19.12	4.14	13.64	10.28%
Tobacco	1.206	Lb	7.23	1.57	5.16	3.89%
Soap	0.004	Ounces	3.36	0.73	2.40	1.81%
Paraffin	0.004	Fl. ounces	3.49	0.76	2.49	1.88%
	Annual wage £		40.3	Total	30.36	100	75.35

Notes:

1. The price of rent was fixed as 10% per annum of the annual wage.
2. Prices for eggs, potatoes, soap and paraffin are taken from Allen's (2001) series for Ghent, as explained in the text.
3. Unit for 'Rent and Repairs' refers to an urban dwelling, which accommodated two adults and four children: an average family size and dwelling for a skilled labourer of the period (Muscat, 1915).

Even if expenditure shares are constant, there is the possibility that inflation differed strongly between regions. That is, the exact same series may be more expensive for inhabitants of a different region in the same country. This, however, applies only to large domestic markets, which Malta is not. The surface area of Malta is 316km^2 – 1.2% the size of its Italian neighbour Sicily – and the longest possible distance that could be travelled, from the southernmost coast (in Marsaxlokk) to the northernmost coast (in Gozo), is 43km. Information, goods and people could move easily within this small country, so the likelihood of inflation differentials large enough to cause relative changes in regional living standards is very low.

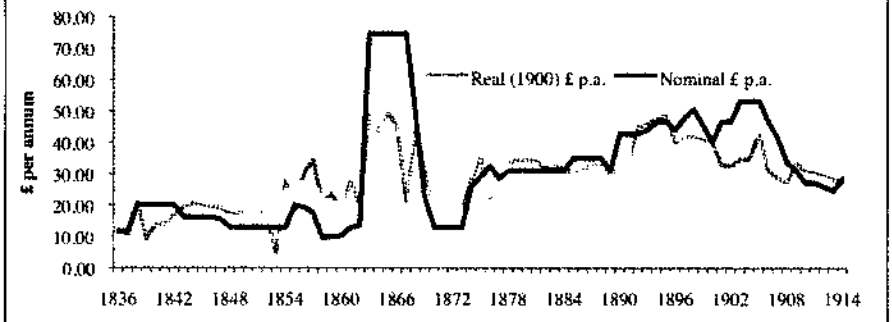
Figure 1. Difference in Consumer Price Index (CPI) with and without Prices from Ghent. 1900=100.



Diets were practically the same throughout the nineteenth and early-twentieth centuries (Cassar 1988). Rent rates are unavailable in the blue books or the secondary sources consulted, so the rate fixed at 10 per cent per annum of the annual wage has been kept, which is the rate listed in the 1930 Royal Commission report. Allen (2001, p. 422) is also unable to find consistent and reliable rent data, but writes that across most European cities *'it generally amounted to less than 10 per cent of expenditure'*, which fits perfectly with the case of Malta. Furthermore, prices for eggs, kerosene, potatoes and soap were taken from Allen's (2001) data for Ghent. Why Ghent? Prices for these goods during this period were unavailable for other European cities. As the expenditure weight of the "Ghent items" is so low (2.63% on average across the period), leaving them out of the basket and re-weighting makes no difference to the overall movement of the price index and hence makes no difference to the real wages. This is displayed in Figure 1.

As this is a new series, it has been displayed in both real and nominal form in Figure 2 for further inspection. The two series move in lockstep, but there are two clear deviations from trend. Prices rose rapidly

Figure 2. Real (1900) and Nominal Wages £ per annum for Skilled Labourers in Malta.



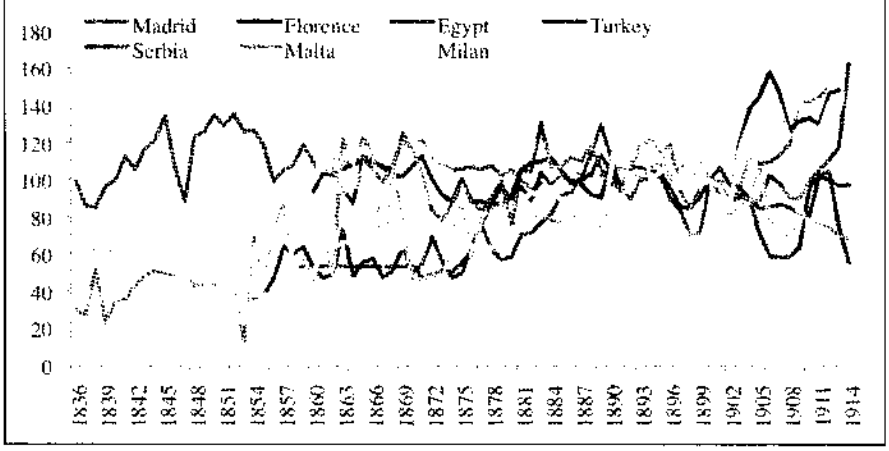
throughout the Crimean War (1852 to 1856) and during the construction of the Suez Canal (1859 to 1869). Inflation spiked during these two periods, due to the presence of (better-paid) British servicemen and the high demand for services and goods. There was still, however, real-wage growth through the ends of both periods, due to the *exceptionally* high demand for labour. This is corroborated by another Royal Commission (1912, p.12) report, which stated that the '*... sudden withdrawal of the British fleet and garrison would reduce a large sector of the population to idleness and starvation.*' Indeed, following these two events and the reduced military presence, both prices and wage stabilise.

With a compound average growth rate of 1.03% per annum, real wages reached £40 per annum by 1914 for a skilled labourer. It appears, though, that real wages were on the decline from the turn of the century onwards. Literary evidence reveals that economic prosperity increased during World War I, mainly due to activity at the dockyards, but that wages continued their decline once the war was over (Attard 1983). On 7 June 1919, crowds gathered in Valletta to protest against the rising prices of food – specifically bread, which was the most important part of the Maltese diet – and to demand higher wages in the British-owned dockyards. All in all, the real-wage trend fits well with the historical record.

4. Empirical Analysis

BEFORE THE EMPIRICAL ANALYSIS is analysed, the real-wage indices are presented alongside one another in Figure 3 below. Figure 3 shows clearly the slow growth during the earlier part of this period described by Williamson (2000). Egypt, Malta and Turkey all converged on the frontrunners Madrid, Milan and Florence during the 1880s and 1890s, but soon afterwards the leaders broke away, experiencing much faster growth from 1900 onwards. Serbia experienced a similar growth path to Turkey, perhaps unsurprisingly, considering their proximity, and to Florence, which is also relatively close geographically. Serbian real wages were in decline until 1910, but rather than going into more of a decline for the final four years as Turkey did, Serbia experienced a final growth spurt that brought it closer to Florentine real wages. Malta experienced two notable growth spurts. The first was during the Crimean War (1852-1856, when the British demand for Maltese workers in Malta was highest) and the second during the construction of the Suez Canal (1859-1869, when Maltese wages had to compete with those being paid in Egypt). Afterwards, however, Maltese wage growth declined, just as did Turkish and Egyptian wage growth.

Figure 3. Real Wages in the Mediterranean, 1836-1914. 1900=100.



Looking at Figure alone, however, it is hard to discern whether there was co-movement and which series moved closest together. Did Serbian real wages, for example, move in synchronisation with Turkish or Florentine real wages? In other words, how were labour markets segmented? An answer is attempted in the PCA.

4.1. Principal Component Analysis

WILLIAMSON (2000) SHOWS the extent of Mediterranean and Atlantic economy integration very well, but leaves the question of the extent of intra-Mediterranean integration open. There are a number of ways of approaching this issue. The most obvious would be to conduct an analysis that takes the entire Mediterranean as a single unit of analysis. This can be done by, for example, analysing the rise or fall of real-wage dispersion (potentially measured by the coefficient of variation) over time. A declining measure of dispersion indicates a more integrated market. This sort of analysis, however, will not show different segmentation within the region. It is possible that the integration of one particular sub-region accounts for the broader falling dispersion. Another potential approach would be to define sub-regions, according to the historical record on migration and trade relations. The problem with this, though, is that the sub-regions could lead to misleading results. Even if sub-regions are defined in accordance with the literature on the subject, the data is still not allowed to speak for itself. A more objective approach is needed.

Factor analysis circumvents these issues. It is a data-reduction technique which detects latent structures underlying variables, and reduces a number of variables into a smaller number of factors. It does this by looking at the co-movement of variables. The correlation of variables is assumed to be evidence of a common factor affecting both variables. If there were two variables, a factor is created as a linear combination of the two and is used to group them.

The variables here are annual time series of real wages from around

Table 3: Variance of Real Wages Explained by Components

Component	Eigenvalue	Proportion	Cumulative
1	2.07085	0.2958	0.2958
2	1.4794	0.2113	0.5072
3	1.14695	0.1639	0.671
4	0.925731	0.1322	0.8033
5	0.774244	0.1106	0.9139
6	0.562743	0.0804	0.9943
7	0.040083	0.0057	1

Notes:
1. Method of extraction was principal component analysis. There are seven real wage series and so seven components. The last two columns show the variance each component explains as a proportion of total variance in the sample, and the cumulative variance explained by the components in descending order.

the Mediterranean. Using factor analysis, underlying factors (or groupings) of the series may be detected. Following this, the groupings (integrated markets) may be further investigated to better understand what was leading to integration. The real-wage series were differenced to avoid spurious correlations. This is particularly important in factor analysis. Using levels would have misled the factor analysis into detecting correlation because of simultaneously rising wage levels.

PCA is most often used, as here, to detect underlying components in datasets. PCA establishes linear combinations of variables, extracting the maximum amount of variance from those variables. This extracted variance is then removed, while a second linear combination is established. This is repeated until all the variance is accounted for by a set of uncorrelated components. The components extracted are displayed in Table 3 below.

The components are ordered in terms of the amount of variance they explain. Deciding on how many components to extract is somewhat arbitrary, though there are guidelines. In the present case, it may be seen that the first three components explain over 67% of the total sample variance. The bigger the eigenvalue, the more of the variance that component explains. The Kaiser criterion has been used, which states

Table 4: Component Correlation Matrix.

Series	Component 1	Component 2	Component 3
Milan	**0.68**	0.07	-0.06
Madrid	0.00	-0.04	**0.68**
Florence	**0.67**	0.08	0.02
Egypt	-0.18	**0.31**	-0.57
Turkey	-0.18	**0.63**	0.20
Serbia	0.16	**0.48**	-0.21
Malta	-0.02	**0.52**	0.35

that all eigenvalues greater than one should be retained. This means the first three components.

The next task is to analyse how the real-wage series relate to the three components. This is done by calculating the correlation coefficients for each real-wage series with the components. Again, it is somewhat arbitrary to decide on what constitutes a strong correlation, and identifying the strongest correlation can only be done in a relative (to the rest of the correlation coefficients) sense. Table 4 below presents the correlation coefficients, highlighting the strongest associations.

The first component groups the variance of Milan and Florence together – two cities, part of the same country, that are very close together. Proximity – and hence lower transport costs – facilitated migration between the two. Furthermore, once part of a unified Italy, there were no political or institutional barriers to movement. They also spoke the same language. The result is, therefore, unsurprising. This component shows no other substantial correlation to any of the other locations, indicating the presence of an integrated *northern* Mediterranean labour market.

Similarly, the second component groups the variance of the south-eastern Mediterranean locations. Again these locations are close to one another as far as the sample is concerned, and we also know there were commercial and migratory links between them. For example, on commercial links, Bateman (2010, p.7) writes that '*... grain was shipped... from Egypt to Venice and from the Balkans to the Turks. Grain also moved east to west from*

the Levant. Southern Italy and Spain exported oil as far as Egypt…' On migratory links, Calleja (1969) writes that there were some 5,000 Maltese immigrants in Egypt in 1865 and 7,000 during the 1880s – around 4% and 5% of the Maltese population, respectively. This component indicates the existence of an integrated *south-eastern* labour market, which broadly matches Ottoman borders. It is also worth considering here that both Malta and Egypt were British colonies during the period, which might have facilitated migratory flows. This grouping reflects the finding of Pamuk (2005), who writes that the eastern-Mediterranean wages showed close association, but that wages in Egypt lagged behind somewhat – Egypt, is in fact, the weakest correlate for this component.

The third component highlights some interesting aspects of the data. It is most strongly positively correlated with Madrid, a location that showed no correlation to the other components. This is, perhaps, not surprising, considering how geographically distant from all the other locations Madrid is. The third component also shows a strong negative correlation and a weaker negative correlation to Egypt and Serbia respectively. What do the two have in common? As stated earlier, the wage series for these two locations are for unskilled labourers: agricultural workers in Egypt and building workers in Serbia. What this third component explains, then, is the demand for a particular type of skilled labour. Indeed, Turkish wages and Maltese wages are also positively correlated to the component. Milan and Florence display no correlation, as their wage series are for skilled builders rather than the skilled craftsmen (as in Madrid), tradesmen (as in Malta) or industrial workers (as in Turkey). Van Zanden (2004, p. 4) makes a similar distinction between worker categories, when writing that *'Masons [as distinct from builders, who are yet lower down the skill ladder] were the architects… of almost all early-modern buildings…'* and that carpenters *'… were the engineers of a technology consisting mainly of wood, and shipwrights, millwrights, wheelwrights and other specialized carpenters were responsible for an important part of new inventions.'* Although it is hard to be sure at this stage,

this "Madrid component" seems to indicate that common economic forces – namely, the demand for certain labour skills – operated across the region. Very much in this vein, Bateman (2010, p. 30) concludes her rigorous study of Mediterranean commodity-market integration by hypothesising that shifting demand forces – and the failure of supply responses, as in Venice – '*... precipitated decline in parts of the Mediterranean.*' Even if this really is the case, the correlation coefficients are mostly low, so the forces would have been weak.

While the same relative demand forces for labour were present across locations, as seen in the "Madrid component", the PCA clearly shows the primacy of geography. Locations that are closer to one another are most similar in terms of real-wage variance. As it stands, it seems that there existed at least three broad labour markets: a northern one (Milan and Florence), a south-eastern one that broadly follows the borders of the Ottoman and British Empires in the Mediterranean (Egypt, Turkey, Malta and Serbia), and a western one (Madrid). Although Pamuk (2005) used a different selection of real-wage series, he arrived at a similar, but broader, geographical division, with Italy and Spain in the west and Egypt and Turkey in the east. Williamson (1998, p. 9) also wrote that '*... the evidence supporting labour-market segmentation between the centre and eastern Mediterranean is powerful...*' If migration is the mechanism that integrates labour markets, then the PCA indicates that distance was its biggest impediment.

4.2. Modelling Labour-Market Integration

NOW THAT SUB-REGIONAL GROUPINGS have been extracted, the next step is to try and understand exactly what was driving or hindering labour-market integration. This is done by using a model presented in Boyer and Hatton (1994). This model permits access to the second research question: can fragmented Mediterranean market integration be explained by different economic shocks or by the absence of migration?

As Boyer and Hatton (1994) write, the main driver towards the

convergence of real wages (indicative of integration) in two labour markets is migration. In the case of two labour markets i and j, migration from i to j can be represented as

$$m_{ijt} = c[\ln(w_j / w_i - k] \qquad (1)$$

where m_{ij} is the rate of migration from i to j (as in negative migration from j to i), c is a parameter that measures the response of migration to a given wage differential, and k measures the non-wage locational advantages of market i relative to market j. The migration rate depends on the wage ratio as well as the mobility parameter, c. A greater wage ratio means a greater incentive to migrate, and hence a greater migration rate. Parameter c determines the degree of integration between two labour markets. If those two labour markets were perfectly integrated, c would be approaching infinity, as labour would be perfectly mobile. If c were measured to be zero, then it would indicate no integration.

Migration has an effect on the wage ratio itself. If then labour would migrate from i to j, assuming that $c > 0$. The increase in market j's labour supply would lower w_j while the reduction in labour in market i would raise w_i. The wage ratio ln would eventually fall and the process would continue until ln=k. There is thus a long-run tendency towards a ratio of =e^k and if k=0 then ultimately =1. In the appendix, Boyer and Hatton's (1994) model of labour demand in each market is reproduced: this model allows for the elimination of migration and the expression of the relation between the two markets in terms of the wage alone. It is based on equation (1) and yields the following empirical implementation

$$\Delta \ln W_{it} = \alpha + \beta_1 \Delta \ln W_{jt} + \beta_2 \ln(W_i / W_j)_{t-1} + \beta_3 T_{ijt} + \varepsilon_t \qquad (2)$$

where β_1 indicates the degree to which there are common shocks that affect both labour markets, and β_2 measures the degree of integration of the two markets. The size β_2 of depends on the mobility parameter c

Table 5. Labour-Market Integration Model Results

Region i,j	Constant	Time Trend	$\ln W_{jt}$	$\ln(W_i/W_{jt})$	R^2	DW	N
Milan, Florence	0.664**	0.001	1.098***	-0.744**	0.902	1.788	53
	-0.28	0	-0.052	-0.336			
Egypt, Turkey	1.177**	-0.001	0.271**	-1.138**	0.148	1.6	56
	-0.453	-0.001	-0.129	-0.456			
Serbia, Malta	0.656**	0.001	0.11	-0.658**	0.123	1.974	52
	-0.317	-0.001	-0.074	-0.286			
Egypt, Serbia	0.448	0	0.022	-0.467	0.047	1.158	52
	-0.347	-0.002	-0.154	-0.423			
Egypt, Malta	0.478**	0	0.047	-0.468	0.06	1.166	56
	-0.283	-0.001	-0.077	-0.307			
Turkey, Serbia	1.025**	0.002	0.253**	-1.175***	0.17	1.981	52
	-0.364	-0.002	-0.148	-0.437			
Turkey, Malta	0.765***	0.001	0.244***	-0.789**	0.216	2.048	60
	(-0.277)	-0.001	-0.067	-0.302			
Madrid, Egypt	-0.596	0	-0.055	0.028	0.047	2.343	55
	0.694	0.245	0.385	0.813			

Notes:
1. DW is Durbin Watson statistic for serial-correlation, and N is number of observations. Models were estimated using ordinary least squares (OLS).
2. Standard errors are in brackets below coefficients.
3. Significance levels: *** (1%) and ** (5%).

outlined in (1): if this parameter equals zero, then β_2 will also equal zero. What it reveals, then, is the degree of integration through migration. In line with the question, these two parameters can help us distinguish between migration and shocks as drivers of integration. and are a time trend and an error term with standard properties.

To match the groupings identified through PCA, the model was run for each pair in each group. While Madrid is, of course, in a grouping alone, the model was run on the Madrid-Egypt pair, given Egypt's correlation with "Madrid component." The results are displayed in Table 5 below.

A quick glance at the results show that most of the coefficients on $\ln W_{jt}$ are positive, indicating that positive common shocks affected both markets. Not surprisingly, this is not the case for Madrid-Egypt. As the

PCA highlighted, Egypt was negatively correlated to the "Madrid component" and this is expressed in the negative sign on $\ln W_{jt}$. Though insignificant, this again hints at the effect of relative labour-skill demands. Its insignificance shows that those forces were weak. The coefficients on $\ln(W_i / W_j)$ are all negative - except for Madrid-Egypt, which is to be expected, given the PCA result and the coefficient on $\ln W_{jt}$. These positive coefficients indicate convergence to a long-run equilibrium wage ratio. However, not all coefficients are statistically significant.

The best results are from the Milan-Florence model, which is to be expected, considering their proximity and the PCA results. This model has the highest explanatory power, and shows through $\ln W_{jt}$ those common economic shocks, arising from changes in labour supply or demand, that affected both labour markets in the same way. The coefficient of $\ln(W_i / W_j)_{t-1}$ is also highly significant and shows that there was indeed wage convergence through migration between the two.

Moving southeast, it can be seen that the integration of Egypt with Serbia and with Malta is not statistically significant. Though the coefficients are correctly signed, their insignificance is somewhat surprising in the case of Egypt-Malta, which were both under British colonial rule. It is known that, for example, during the construction of the Suez Canal, many Maltese labourers emigrated to Alexandria (Calleja, 1969). Perhaps these isolated events were not substantial enough to indicate integration over the whole 56-years. It is worth pointing out, though, that $\ln(W_i / W_j)_{t-1}$ only narrowly misses significance at the 10% level. This indicates that there were at least some migratory flows between the two, and that this had a slight effect on wage convergence. The model's performance is weaker for Egypt-Serbia, but this is less surprising. While the PCA is likely to have placed the two in the same group due to common variation arising from a shared Ottoman-institutional heritage, there is, as far as is known, little evidence of migration between the two (Ferenczi and Willcox 1929). Indeed, the PCA shows that Egypt had the weakest correlation to the group component. Pamuk

(2005) also writes of the lag in Egyptian wages relative to its eastern Mediterranean neighbours.

Serbia was more integrated with both Malta and Turkey. This tighter integration is likely to be a function of distance, which is a fundamental barrier to migration. Serbia is closer to both Malta and Turkey than it is to Egypt. Geographical proximity makes for easier migration mainly through lower transport costs. Indeed, just looking at the results of the PCA and the model makes it clear that there is a negative correlation between distance and labour-market integration. The model's performance tends to improve the greater the proximity. However, the strong results for Turkey-Malta, a pair further apart than Egypt-Turkey yet with slightly better results, tells us something about common shocks. The Crimean War, which involved Malta in that the British used the country as a base, is likely to have sent shocks to labour demand in both locations. Maltese real wages do spike through the war years, pushing them even above Turkish real wages at one point, and later returning to similar levels.

Close Turkish-Serbian integration is encouraged both by distance and by a common Ottoman heritage, which is likely – and this is speculative – to have increased the chances of common shocks as well as the ease of migratory flows. The Mediterranean provides a promising testing ground for untangling the deeper institutional and geographical causes of integration, and it is hoped that this paper serves as a starting point for that research. Even now, though, it seems reasonable to conclude that a semblance of integrated labour markets existed. While some of the coefficients miss statistical significance, there is still an overarching trend of both common shocks and wage convergence within a fragmented labour market.

Conclusion

IN THIS PAPER, PCA has been used to uncover underlying relationships between a sample of Mediterranean real-wage series. To this end, a real-

wage series for Malta has been constructed. PCA revealed that the Mediterranean was split into at least three labour markets, represented in the west by Madrid, in the north by Milan and Florence, and in the south-east by Egypt, Turkey, Serbia and Malta. These relationships were further tested by using a labour-market integration model from Boyer and Hatton (1994). The model results indicate that the labour market integration of sub-regions within the Mediterranean was driven, to varying degrees, both by common shocks to labour supply and demand, as well as by migration. There is much scope for future research to drill deeper into the determinants of integration: if migration drove integration, then was it distance or institutional characteristics that drove migration, and what exactly were the common supply or demand shocks?

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APPENDIX

Mediterranean Labour-Market Integration: Maltese Real Wages in a Regional Context, 1836-1913

I. Basis of empirical model

This appendix contains a reproduction of the model of labour demand, which forms the conceptual basis of (2), as outlined in Boyer and Hatton (1994, p. 103).

In the two labour markets, *i* and *j* respectively, labour demands are

$$\ln L_{it}^{t} = a_i \ln W_{it} + D_{it}, \qquad \ln L_{jt}^{t} = a_j \ln W_{jt} + D_{jt} \tag{A.1}$$

where W_i, W_j are nominal wages and all other factors (e.g. output prices) are in the demand shift terms D_i, D_j. Changes in labour supply are simply the differences between rates of natural increase, *n*, and rates of net emigration, *m*, so that

$$\ln L_{it}^{s} = s_{it} - \mathrm{m}_{it}, \qquad \Delta \ln L_{jt}^{s} = \mathrm{n}_{jt} - \mathrm{m}_{jt} \tag{A.2}$$

Rates of emigration are determined by the geometric weighted average of the wage rate in the other region (*i* or *j*) and in the third market, *z*, relative to that in the own market:

$$\begin{aligned} \mathrm{m}_{it} &= \beta_i [s_i \ln W_{jt-1} + (1-s_i) \ln W_{zt-1} - \ln W_{it-1} + k_{it}] \\ \mathrm{m}_{jt} &= \beta_j [s_j \ln W_{it-1} + (1-s_j) \ln W_{zt-1} - \ln W_{jt-1} + k_{jt}] \end{aligned} \tag{A.3}$$

where s_i, s_j represent the 'weight' of the third market immigration decisions in *i* and *j*, and k_i and k_j represent the non-wage advantages of location *i* and *j* relative to the weighted average of the others.

Converting the labour demand equations to changes and setting $\Delta \ln L_t^d = \Delta \ln L_t^s$ for both markets gives

$$\begin{aligned} \mathrm{m}_{it} &= \mathrm{n}_{it} - a_i \Delta \ln W_{it} - \Delta D_{it} \\ \mathrm{m}_{jt} &= \mathrm{n}_{jt} - a_j \Delta \ln W_{jt} - \Delta D_{jt} \end{aligned} \tag{A.4}$$

Using equations (A.3) and (A.4) to eliminate m, we obtain

$$\begin{aligned}\Delta \ln W_{it} &= \frac{n_{it}}{a_i} - \frac{\Delta D_i}{a_i} - \frac{\beta_i}{a_i}\left[s_i \ln W_{jt-1} + (1-s_i)\ln - \ln W_{it-1} + k_{it}\right] \\ \Delta \ln W_{jt} &= \frac{n_{jt}}{a_j} - \frac{\Delta D_j}{a_j} - \frac{\beta_j}{a_j}\left[s_j \ln W_{it-1} + (1-s_j)\ln W_{zt-1} - \ln W_{jt-1} + k_{jt}\right]\end{aligned} \tag{A.5}$$

Finally, eliminating W_{zt-1} by combining the two expressions in (A.5) gives the following

$$\begin{aligned}\Delta \ln W_{it} = {} & \frac{n_{it} - \Delta D_{it} - \beta_i k_{it}}{a_j} - \frac{\beta_i(1-s_i)}{\beta_j(1-s_j)} + \left[\frac{n_{jt} - \Delta D_{jt} - \beta_i k_{ij}}{a_i}\right] + \\ & \frac{\beta_i a_j(1-s_i)}{\beta_j a_i(1-s_j)} \Delta \ln W_{jt} + \frac{\beta_i(1-s_i s_j)}{a_i(1-s_j)} \ln(W_i/W_j)_{t-1}\end{aligned} \tag{A.6}$$

Equation (A.6) is essentially the equation used for estimation. The terms ΔD reflect demand conditions which are not in the estimating equation. If the variables driving labour demand are integrated of order 1 (as is common with price series) then will be integrated of order 0 and will form random disturbance. In the estimating equation, the variables n and k are treated as constants, but any secular changes are captured in the time trend which is added to the model. The coefficient on $\Delta \ln W_{jt}$ is expected to be positive and would be close to one for two symmetric regions. The coefficient on $\ln(W_i/W_j)_{t-1}$ will be negative since a_i, the labour demand elasticity, is expected to be negative. It is important to point out that the lower the migration elasticity, β_i, which shows the degree of labour mobility, the smaller is the coefficient on the error correction term in the equation.

II. Real Wage and CPI Series for Malta, 1836-1914. 1900=100.

Year	Real Wages	CPI	Year	Real Wages	CPI
/	/	/	**1875**	87.48	83.20
1836	30.28	96.16	**1876**	56.78	142.49
1837	26.88	108.30	**1877**	80.20	88.73
1838	52.35	95.79	**1878**	83.24	93.26
1839	23.29	215.20	**1879**	86.61	89.65
1840	35.17	142.55	**1880**	85.80	90.49
1841	35.20	142.47	**1881**	84.89	91.46
1842	42.83	117.06	**1882**	80.04	97.01
1843	48.27	83.77	**1883**	80.75	96.17
1844	51.18	79.00	**1884**	78.39	99.06
1845	49.56	81.61	**1885**	76.25	114.55
1846	48.95	82.64	**1886**	79.07	110.48
1847	47.75	81.29	**1887**	81.82	106.77
1848	42.96	75.27	**1888**	81.72	106.87
1849	43.77	73.90	**1889**	73.60	105.49
1850	43.00	75.25	**1890**	85.34	125.11
1851	44.78	72.24	**1891**	84.57	126.24
1852	40.73	79.46	**1892**	111.84	95.46
1853	12.68	255.22	**1893**	114.95	95.69
1854	68.62	47.15	**1894**	119.22	97.71
1855	46.04	108.92	**1895**	121.22	96.07
1856	74.54	65.09	**1896**	99.97	110.02
1857	85.77	50.93	**1897**	104.11	114.97
1858	51.28	47.32	**1898**	104.37	120.88
1859	58.69	42.73	**1899**	101.68	111.34
1860	44.65	57.96	**1900**	100.00	100.00
1861	69.36	46.63	**1901**	82.01	142.01
1862	49.30	68.91	**1902**	81.01	143.75
1863	121.64	152.91	**1903**	86.64	153.10
1864	108.57	171.35	**1904**	86.61	153.16
1865	122.58	151.75	**1905**	106.28	124.82
1866	113.94	163.24	**1906**	77.58	150.10
1867	53.61	347.00	**1907**	71.72	144.33
1868	107.41	112.97	**1908**	68.49	122.84
1869	76.48	74.02	**1909**	83.66	92.81
1870	46.85	69.08	**1910**	76.93	88.32
1871	46.07	70.24	**1911**	76.35	88.96
1872	48.11	67.25	**1912**	73.96	87.49
1873	44.97	71.96	**1913**	70.53	87.14
1874	69.78	92.74	**1914**	68.04	104.59