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Pepelasis, Ioanna Sapfo and Emmanouilidi, Elpianna

Dept. Economics, Athens University of Economics and Business,
Athens, Greece

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**Joint Stock Company births: historical coincidence and economic causality
(Greece, 1830-1909)**

Ioanna Sapfo Pepelasis* and Elpianna Emmanouilidi†

*Department of Economics, Athens University of Economics and Business,
Athens, Greece*

Abstract: Research on the history of incorporation has focused on advanced countries. This paper differs in that it examines gross joint stock company (JSC) births in Greece, a latecomer country and uses a new dataset constructed from the charters of JSCs. We map evolution in the number, capital, and sectors of JSC start-ups founded between 1830 and 1909 and show that peaks in JSC birth counts coincided with big events. We also use empirical time series analysis and explore whether a causation mechanism existed between the meso-phenomenon of incorporation and the macro-level process of economic growth. For this purpose we employ time series macro-indicators (GDP and in particular agricultural GDP). Our main empirical finding is that a ‘virtuous circle’ was at work. Namely, agricultural surplus provided the financial resources for joint stock company births, and the latter enhanced the enlargement of the avant-garde margin in services and industry which in turn ‘pushed forward’ agricultural and in consequence total GDP.

Keywords: joint-stock company birth counts, time series application, Granger causality, agricultural GDP, Greece.

JEL: N130; N830.

* ipepelasis@aueb.gr;
† elpemman@aueb.gr

Introduction

General remarks linking the dissemination of the joint stock company to economic growth, have been made in the literature by Joseph Schumpeter (1947, 1963); Simon Kuznets (1966); Douglass C. North and Robert Paul Thomas (1973).¹ Recently, within the expanding body of research on the joint stock company,² some academics are creating historical data bases which systematically explore links between the corporate sector and the broader macro context of economic change. Notable outcomes have been cross-section international comparisons in corporate demography (notably Hannah and Foreman-Peck, 2012); and specific country case studies on the evolution of incorporation over time. Examples of work in this latter direction are: Richard Sylla and Robert E. Wright (2012)³ and Robert E. Wright (2011) for the USA; Pierangelo Toninelli (2012) for Italy and Pedro Neves (2011) for Portugal.⁴ Strictly speaking a common research agenda does not yet exist, but this paper on Greece, a latecomer country,⁵ may be considered as part of this new trend.

Up to now, the historiography on the Greek joint stock company (henceforth, JSC) has been largely of a legal orientation.⁶ The earliest economic analysis of the JSC (or *société anonyme*) was undertaken by Angelos Angelopoulos in his pioneering 1928 study, in which he combined a public finance perspective with some basic statistics of JSC births up to 1928. Thereafter, apart from a few fleeting references to the JSC, there was silence for too many decades, as scholars were preoccupied with analysing the life path of individual entrepreneurs/family businesses, usually in commerce and shipping, two sectors in which incorporation has not been predominant. Only in banking and industrial historiographies, has the JSC entered the picture, although circumstantially and indirectly.⁷ The first work after Angelopoulos to focus on the Greek JSC from a business/economic history perspective has been the quantitative study of Stathis Tsotsoros (1994) which offers a compiled statistical database of the balance sheets of industrial JSCs during the interwar period.

Our paper examines JSC births between national independence (1830) and 1909, the year of the military uprising of Goudi, the so-called Greek ‘bourgeois revolution’.(Dertilis, 1977; Mavrogordatos, 2003).⁸ In Section 1 we outline the main transformations in economy and society during the period under review. Section 2 sketches the implantation, legal framework and ownership basis of the JSC. In

Section 3 we present our data base and map the annual count of JSC births and associated annual total incorporation capital and sectors. We also focus on the high count JSC birth episodes and discuss the wider historical conjunctures during their occurrence. We then proceed, in Section 4, on the basis of time series analysis to examine whether JSC births were causal in the Granger sense with retrospective GDP estimates, in particular agricultural GDP. Finally, having established a certain degree of reciprocal causality between agriculture and gross incorporation, we go a step further and investigate whether it would be a valid case to assume the existence of a long-run relationship between registered incorporation capital and agricultural GDP and try to integrate short-run dynamics with long-run equilibrium, quantifying such propensity to adjust. Section 5 summarizes the main findings.

1. Transformation in economy and society, 1830–1909

In 1830, the newborn Greek state was a small agrarian kingdom devastated from war. The economic backwardness of the country was multifaceted: It lacked a transportation infrastructure and had no industry. Banks were non-existent; hoarding and usury were the main financial activities. There was no modern framework of individual property rights and most of the population was illiterate. Subsistence agriculture prevailed with the notable exception of the heartland of currant production in the western Peloponnese- a region that had a long tradition of exportation and strong links with the vibrant international communities of Greek diaspora merchants (Clogg, 1992; Gallant, 2001: 34–40; Dertilis, 2010; Pepelasis, 2005).

By 1909, although Greece remained economically in the backwaters of Europe, it had become in many respects quite a different land.⁹ Population and territory had increased substantially and so had the standard of living and literacy. The country was also near the completion of its railway network, and although it was not experiencing an industrial revolution, there were some factories in its economic landscape and urbanization was on the rise. Moreover, by 1909, it was a much more open economy. Foreign capital inflow (largely in the shape of loans to the state) had reached unprecedented heights. International trade and the monetization of transactions were continuously rising. The subsistence economy was gradually giving way to a mercantile-type family capitalism characterised by business ventures, mostly linked to commerce and shipping (Kostelenos et al 2007, Dertilis,

2010; Haritakis, 1927: 3-40; Thomadakis, 1981: 77-151; Kostis and Kostelenos, 2003: 17-38; Franghiadis, 2007: 83-109).

Economic advancement and the contrasting so to speak conditions, between 1830 and 1909 give rise to following question: Was progress smooth or was there a specific point at which there was a leap forward? The evidence is in favour of the existence of a multiple turning point in 1871/3 which instilled/triggered a new dynamism.

In the sphere of the economy, by this point in time the country had recovered from the physical devastation brought about by the War of Independence. In addition, it was larger in area as it had recently acquired the westernized Ionian Islands (1864) and was experiencing its first industrial stirrings (c.1867-1874). Greece had also just embarked on a near twenty year boom in currant exports. The striking moving forward from 1871/3 onwards is also evident in the performance of two basic macro-indicators. Whereas before, average per capita GDP had been more or less static, it was now increasing. Moreover, the average annual growth rate of GDP was higher in the post 1871/3 period as a whole.

The higher economic vivacity of the post 1871/3 period encompassed so to speak an outward shift in the production possibility frontier of Greece, as a result of : the annexation the large and fertile regions of Thessaly and Arta (1881) and the post 1879 in-pouring of syndicated loans. Among the various underwriters were diaspora bankers, some of whom had repatriated to Greece in the early 1870s; the emblematic figure being the Constantinople merchant banker Andreas Syngros who became a resident of Athens in 1872 (Pepelasis Minoglou, 1995, 2002; Pandelakis, 1995).

Insert Tables 1- 3 here

Turning to the political/institutional sphere, we observe that the 1871/3 turning point lay between two important reforms: the adoption of parliamentary monarchy/universal suffrage (1864) and the introduction of the principle of ‘δεδηλωμένη’ (1875), i.e. governing on the basis of parliamentary majority. Perhaps, more importantly, this turning point coincided with the introduction of the radical Law for the distribution of ‘national estates’ (1871)¹⁰ which the consequent commoditization of land and strengthening of property rights. In addition, in the decades that followed there was an intensification of westernization in the legal process. Customary law was in practice progressively superseded by a more unified

legal system which used the German Civil Code as its point of reference (Dacronia, 2003; Clogg, 1992, Ch. 3: 47-81). Finally, after 1871/3 onwards there was pronounced evolution in the sphere of public finance as the abolition of the tithe and corollary tax farming in 1882 enhanced the rise of monetary tax revenues and hence monetization. .

In conclusion, between 1830 and 1909 Greece was a backward but not static economy. There was economic change and the average annual rate of growth of GDP for the period as whole was above the 1% benchmark for the occurrence of modern economic growth.¹¹ Evolution however was not evenly spread out over time. Following a long post-independence recovery period, the country in 1871/3 experienced a multifaceted turning point and made a leap forward. There was a transition from relative economic stagnation to a quickening in socio-economic change and the introduction of new institutional arrangements.

2. Implantation, legal framework and ownership basis of the JSC

The birth /implantation of the JSC in Greece coincided with nation building. The first JSC was founded in 1828 by Governor Ioannis Kapodistrias, an ex-diplomat of the Russian Empire who had become the first head of state of the previous year. This JSC was the state bank ‘Ethniki Hrimatistiki Trapeza’, and after a nebulous existence, it was dissolved in 1834, shortly after the assassination of its founder.¹² Following independence in 1830, the first new JSC to be registered was the marine insurance company ‘I Achaia’, established in 1836. This and all other posterior JSCs were set up under the framework of Articles 29–37, 40 and 45 of the Commercial Law Act of 1835, which formally incorporated the Napoleonic Commercial Code of 1807 into Greek Law. No Company Act was introduced in the period under study in spite of two attempts to do so, one in 1889 and a second in 1896. Hence it is not possible to explain evolution in JSC births (Sections 3 and 4) to change in commercial law! And this is something we wish to set straight right from the start (Karavas, 1930; Koutsis, 1944).¹³

Lastly, before moving on to an analysis of the data base a few words are necessary regarding the ownership of JSC start-ups. The great majority of JSCs were private companies i.e. they were not listed on the Athens stock exchange (est.1876, starting date for trade in shares, 1880). They were also private affairs in the sense that the state was near absent as a founding shareholder. Unlike however most Greek

companies, JSC start-ups were rarely strictly speaking family firms and the average number of founding shareholders per JSC for the period under review was 39. On the whole, incorporation was a local affair as foreign(ers) shareholders were few among JSC start-ups, with the notable exception of railways and other public works/utilities. Finally, the typical profile of leading shareholders was that of a male member of the socio-economic elite (often an already successful businessman). He would either have tight links to the mercantile diaspora or be himself a repatriated member of this diaspora.¹⁴ With these few remarks on the dramatis personae/ the creators of JSC start-ups (which are hidden in this paper) we now proceed to our historical and empirical analysis of the data base.

3. Historical analysis of the JSC database

3.1 Description of the database

The newly compiled database on which this paper is based includes gross incorporation (births) of JSCs rather than net incorporation (births minus deaths) as, at the time, existing companies were not obliged by law to declare dissolutions. It covers the total population of 303 new JSCs (i.e. not reconstitutions of active firms) established in Greece between 1830 and 1909 and draws on information from all the (royal) legal decrees of incorporation and the 251 founding charters which have been recorded in the *Greek Government Gazette* and located in archives.¹⁵

The following information has been drawn from the data base per start-up: date of birth; sector;¹⁶ registered and paid capital. Capital information is not available for start-ups founded before 1840. For analysis purposes, we rely on 294 JSC births observed during 1840-1909, 18 self-help associations included. A histogram of the JSC birth count is provided in Figure 1 while summary statistics by decade, and by decade and sector, are provided in Tables 4-5(a-b). For estimation purposes, we construct a sample of 70 annual time series observations during 1840-1909. In this respect, we consider the annual count of JSC births (including zero counts) and the associated year-total of real registered and paid capital. The temporal evolution of births and real capital is depicted in Figures 2 (births and capital series - levels), and 3 (births – levels and changes) while that of total, non-agricultural and agricultural GDP in Figure 4 (GDP – level and annual growth rate). All monetary amounts are in log-real terms (1914=100, deflator base year) and expressed in Drachmas, henceforth Drs.¹⁷

3.2 JSC birth counts

The number JSC start-ups established during our period of study seems to have represented only a small fraction of the general population of enterprise births in Greece at the time.¹⁸ The great majority of the latter consisted of individual proprietorships or family based partnerships, usually general.¹⁹

On average, the annual occurrence was less than four new JSC births. Within this rather anaemic rhythm, actual incorporation varied greatly in size from year to year.²⁰ There were years with none or only one JSC company birth, whereas in particular times there were leaps and bounds. However, although no consistent upward momentum can be observed in the number of births, the early 1870s were a watershed. For the period under study it was at this time (1872/3) that the annual count of JSC births reached an all time peak. Moreover, the majority of years during which there were none or only one start-up are located before 1872/3 and over 75% of JSC births occurred from then onwards. It should be underlined here that there was also a seminal shift in the sectoral allocation of JSC births. Up to 1872/3 the nascent corporate sector was a ‘monoculture’, as there was a near exclusive presence of marine insurance companies among start-ups. From then onwards: marine insurance nearly disappeared; the share of services within the total population of JSC births fell and within services banking acquired an important presence. Moreover, the drop in services was offset by a rise in the share of industry, especially mining, but also construction and modern manufacturing- activities which lay outside the traditional and predominant scope of the non-corporate manufacturing sector, i.e. food/agricultural products processing and textiles.²¹

Insert Figure 1 and Tables 4 and 5 here

3.3 Registered and paid in capital of JSC start-ups

Based on the statistics provided by Table 4 (under ‘Total’), known registered capital recorded for the 294 start-ups amounted to a total of 1,057,662 and known paid capital to a total of 168,817,000 Drs i.e. a registered to paid capital ratio of 6:1 despite a slight difference in the number of capital records available. In reality, total incorporation registered capital was much larger than 1.06 billion Drs. But even this known capital commitment was significant in the capital-poor Greek economy. It was equivalent to 60% of the credit granted to private business by the leading financial institution, the National Bank of Greece, over our period under review

(Dertilis, 2010). In terms of the evolution of incorporation, as was the case with birth counts and sectoral composition, the year 1872/3 was also a seminal watershed for capital commitment. Nearly 90% of the total known registered capital of JSC start-ups belongs to the post 1870 decades.

Insert Figure 2 here

Finally, let us note that the JSC became a vehicle for the rise of large-scale productive units, a *sine qua non* requirement of Kuznetian economic growth. The median registered start-up capital of Greek JSC companies was low by Western standards,²² but it was nevertheless emblematic of big business in Greece. An initial sample of the material on the founding capital of partnership-based firms suggests that the median registered capital of individual corporate entities was much higher (especially for railways and banks) compared to the capital endowment of non-corporate firms.²³

To recapitulate. In the period under review, the number of JSC birth counts was rather low (compared to births in the ‘non-corporate’ sector). However, incorporation was highly significant in terms of: capital commitment; the introduction of: avant-garde activities (in an economy in which the largest sector outside agriculture was micro-commerce); and large scale unitary firms. Finally, we have detected the existence of evolution and a structural break in JSC birth counts, sectors, total capital commitment in 1872/3 that coincided with the multifaceted seminal turning point in Greek economy and society (Section 1).

3.4. Episodes of high level JSC birth counts: basic characteristics and historical conjuncture

Up to this point in the historical analysis of the JSC births data set we have referred only to the 1872/3 structural break and have left out the other six instances of high level JSC birth counts. In this section we make up for this omission. We discuss and compare the characteristics of all peaks and focus on the significance of timing (historical conjuncture).

Insert Table 6 here

Phase I: 1830-1871

In the first forty years of statehood the total number of JSC births was as a whole unimpressive. However, in the 1860s thrice there were valuable signs of activity in JSC births (1860, 1862, and 1866). The count of JSC births in each of these three episodes (8, 10, 8 respectively) were a preamble to the structural break of 1872/3 (55 births). The short time spans separating them suggest that a cumulative spirit of rising expectations was in the air which reached its highest point in 1872/3. How did this come about? In the early to mid-1860s after a post-independence thirty year readjustment phase, things were beginning to move forward in the economy. The country was at the eve of its first industrialisation spurt (c. 1867–1874) (Agriantonis, 1986). However, it was two non economic events, both in 1864, which seem to have acted as ‘Kindlebergian displacements’ which enhanced the developmental potential of Greece and had a ‘liberating effect on entrepreneurial spirit’ (Kindleberger and Aliber, 2005). These were the accession of the Ionian Islands -Greece’s window to the West- and the introduction of universal suffrage.

Phase II: 1872-1909

This second phase which opened with the structural break of 1872/3 witnessed three additional distinct high level episodes (1882/3, 1893, 1907-9). The characteristics of the 1872/3 watershed (55 JSC births), were presented in Sections 3.2 and 3.3 above. This mother of all peaks coincided with an expansion in business horizons as a result of the historical conjuncture of the 1871/3 turning point in economy and society (Section 1). There was a spirit of business euphoria/aggressiveness prompted by recently repatriated diaspora bankers (Dertilis, 1989) and their intense wave of speculation in mining shares which came to an abrupt end with the burst of the infamous Lavrion mine bubble in 1873. An event which nearly coincided with a wider European phenomenon of stock market crashes (Yiannitsis, 1977: 239; Angelopoulos, 1928: 15-16; Kindleberger, 1993: 195-196).

In the next two decades there was a nearly even distribution of two repetitive episodes of high annual counts in JSC births. The first was in 1882/3 (19 birth counts). The second followed in 1893 (12 birth counts). These figures suggest the existence of a deflating of the 1872/3 cut-off point in the next two decades. Given the ‘shock’ of the 1873 crash in mining shares and the wide publicity it brought about for the JSC as an institution, it is surprising that these peaks occurred at all. Perhaps, one could argue that from 1872/3 onwards there was a general rise in the

self-confidence of the nation and its novel institutions (aka, the JSC) which made business persons more receptive to the idea of creating start-ups ‘when the occasion occurred’. By the latter meaning when there were distinct exogenous/big events.

With regard to the 1882/3 peak in JSC births, the big event was the accession in 1881 of the Thessaly-Arta region. Its large grain-rich plains made imperative the creation of large (i.e. JSC based) transportation and banking infrastructures. The ability to carry these out was made possible as a result of a lifting in 1879 of a 36 year embargo on foreign loans to the Greek government which made possible the external financing of the construction of a national railway by Greek registered JSC start-ups (Papayiannakis, 1982).²⁴ One last comment regarding the 1882/3 peak in birth counts: One year before, i.e. in 1881 there was also a unique/one-off climax in registered capital of 341,118,730 Drs of JSC start-ups! This all time high was associated with the creation of the JSC ‘Bank of Epirus-Thessaly’ in which Syngros was the main shareholder.

The 1893 peak in JSC births coincided with the collapse of the Corinthian currant export sector which in turn led to the moratorium on foreign public debt in December 1893.²⁵ More research has to be done at this stage, but it seems plausible that the collapse of currants perhaps acted as a ‘shock’ which triggered a substitution effect - a shift into new activities through the venue of incorporation (Franghiadis, 2007). The 1893 ‘peak’ can also be partly associated with rising expectations. There was an intense sense of achievement in the building of the new Greece during this year: as a result of the fact that the national railway project was in full swing, and the inauguration of the Corinth Canal, the construction of which was completed by a Greek-nominal JSC company (Papayiannopoulou, 1989: 37-42).

After an interval of 14 years, there was a new upward movement. The peak of 1907-1909 was longer than all the previous ones and at 40 birth counts it was nearly as high as the 1872/3 structural break. Notably, the 1907-9 peak was placed at the tail-end of a so-called ‘economic miracle’ (1905-1910) (Dertilis, 2010; Kostis and Kostelenos, 2003: 17-38) and it coincided with an emblematic moment of empowerment of the bourgeoisie, the 1909 ‘Goudi’²⁶ uprising. At this point we would like to add that research on JSC births after 1909 portrays that this last episode of high level birth counts was in essence not simply a peak, but the starting point of the take-off of incorporation to unprecedented heights. For during the twenty one years (1909 to 1929) the birth count of JSCs was 721 vis-à-vis only 303

for the much longer period under study here (1830-1909) (Pepelasis and Aivalis, 2012).

We would like at this point to close the analysis of JSC peaks with two comments on sectoral composition. On the basis of birth counts each successive peak episode had its own signature- was more diversified (entailed a greater variety of sectors). However, on the basis of the sectoral composition of the registered capital of start-ups, we observe from 1872/3 onwards an emblematic continuity: the financial sector held centre stage in all peak episodes: The 1872/3 structural break was driven by banks and mining; the 1882/3 high birth count by railways and banks; the 1893 peak solely by banks; and the final 1907/9 peak by shipping and banks.²⁷

In concluding our historical examination of the data base, we would like to underline that ‘History mattered’. It is time now to go further and search for a quantitatively based causation. Namely explore whether the meso-phenomenon of incorporation interacted with the macro-level process of economic growth by employing empirical methods and examining time series macro-indicators (GDP and in particular agricultural GDP).

4. Empirical analysis

The preceding historical analysis and our data base allow us to make three assertions which we are able to test with empirical analysis. It should be mentioned that of all retrospective GDP estimates, we focus on agricultural and to a lesser extent total GDP, as the former series exhibits relatively greater variation over the 70-year period under study, and such variation is an important ‘ingredient’ to econometric estimation whatsoever. Total GDP estimates are reported for robustness.

_____ *Insert Figures 3 and 4 here* _____

Assertion 1 *There is evidence in favor of a structural break in gross incorporation in 1872 as explained by agricultural GDP. In fact, the count of 16 JSC births in 1872 is an extreme event following the agricultural reform of 1871 (first ‘big event’). It is the second-highest in magnitude, the highest being the count of 39 JSC births in the following year, 1873. However, both events occur with the same frequency, the latter (39 in 1873) being more of an outlier.*²⁸

Empirical proof: The reader may refer to the histogram of all 294 JSC births over the period 1840-1909 (Figure 1) and the time plot of the 70 annual JSC birth count

observations over that period (Figure 2 – Top panel). Empirical evidence is provided in Table 7: assuming a structural break in 1872, pooled and nested estimates from a standard Poisson regression of JSC birth counts on log-real agricultural GDP for the period 1840-1909 (70 time series observations) are reported in the left panel along with the outcome of a likelihood ratio diagnostic test for a structural break in 1872 at the bottom. The right panel reports estimates of the negative binomial counterpart of the pooled Poisson model, based on a parameterization of the Poisson regression to accommodate overdispersion (the alpha parameter). Even though there is indication of over-dispersion in the Poisson conditional mean of over 90%, we report this finding with caution as it is not statistically significant, not to mention the relatively low model fit. However, it might be indicative of a certain degree of sectoral concentration.²⁹

Insert Table 7 here

Assertion 2 *Gross incorporation in Greece during 1840-1909, as measured by the log-count of JSC births, was causal (as opposed to coincident) with the Greek economy, as measured by total, non-agricultural and agricultural GDP on the basis of retrospective estimates. As far as GDP is concerned, causality is reciprocal in case of agricultural (and total) as opposed to non-agricultural GDP.³⁰ Reciprocal causality is evidence of agricultural surplus transformation into industry and services, the transformation process being real capital investment using the JSC as the main business organization unit.*

Empirical proof: Empirical evidence is provided in Table 8 which reports estimates of a Structural Vector Auto-Regression (SVAR) of the log-count of JSC births on log-real total, non-agricultural and agricultural GDP, on the basis of 34 (out of 70) time series observations corresponding to those years during 1840-1909 with non-missing registered and paid capital, namely: 1849, 1854, 1856-1862, 1864-1873, 1881-1882, 1893-1894 and 1899-1909. In particular, JSC births are Granger-caused by all GDP measures i.e. GDP makes a difference in the forecast of the current level of JSC births after controlling for past values of GDP in addition to past values of JSC births. However, causation is reciprocal (both directions) in case of agricultural (and total) as opposed to non-agricultural GDP.

Insert Table 8 here

Assertion 3 *Assuming the existence of a long-run equilibrium relationship between the growth rates of incorporation capital and GDP, the growth rate of agricultural (and to a lesser extent of total) GDP tends to adjust back to long-run equilibrium, as implied by short-run dynamics. The associated propensity implies a positive impact of 2.56 (1.64) in case of agricultural (total) GDP. Magnitudes are relatively lower when the growth rate of paid capital is considered instead.*

Empirical proof: Empirical evidence is provided in Table 9 which reports four sets of estimates of a Vector Error Correction Model (VECM) for log-real registered (paid) capital and log-real agricultural (total) GDP. As in case of assertion 2, estimation is based on 34 (out of 70) time series observations corresponding to those years during 1840-1909 with non-missing registered and paid capital, namely: 1849, 1854, 1856-1862, 1864-1873, 1881-1882, 1893-1894 and 1899-1909. Having proved that JSC births and agricultural GDP are mutually causal (assertion 2), we go a step further and estimate the long-run propensity to revert back to equilibrium assuming the existence of a long-run equilibrium relationship between JSC registered (paid) birth capital and agricultural (total) GDP this time. This propensity is derived post-estimation on the basis of the parameter involved in the associated cointegrating vector. In general, if two series are cointegrated, they will be drifting according to their own trend but the difference between them will not grow over time because they are dominated by a common trend. Cointegration requires the presence of a unit root in one of the two series. According to Table 9, the existence of a valid cointegrating vector in case of the respective GDP system equation implies that the growth rates of agricultural (total) GDP and registered (paid) capital tend to evolve together in the long-run. The associated adjustment propensity (rate) is negative in all four systems considered implying positive impact on the part of agricultural (total) GDP.

Insert Table 9 here

A note on cointegration: In the bivariate case, if two series y_t and z_t , are cointegrated, with cointegrating vector equal to $[1, -\theta]$, the one indicating the unit root, then both variables, as well as their linear combination (implied by the cointegrating vector), will be stationary: Δy_t , Δz_t , and $(y_t - \theta z_t)$. An Error Correction Model (ECM) describing the equilibrium relationship will be relevant and internally

consistent only if the two processes are indeed cointegrated (Engle and Granger, 1987).³¹ If the adjustment parameter of the cointegrating vector is negative, it should be interpreted as pushing y_t back to θz_t whenever it under-/overshoots the equilibrium level. For estimation, we rely on the reduced form of the standard ECM's VAR representation, as follows:

$$\begin{cases} y_t = \Gamma y_{t-1} + \varepsilon_t, \text{ VAR with } y_t = [y_t, z_t]' \\ y_t - y_{t-1} = (\Gamma - I)y_{t-1} + \varepsilon_t \\ \Delta y_t = \Pi y_{t-1} + \varepsilon_t \text{ reduced form} \end{cases}$$

The number of independent cointegrating vectors equals $r < n$ as implied by the rank of matrix Π . In the bivariate case, Π has restricted rank equal to $r = 1$.

5. Epilogue

In Greece, the JSC came with nation building. Initially, introduced from above, it functioned under the framework of the Napoleonic Commercial Code of 1807 which remained unchanged.

Historical analysis of the database shows that incorporation: 1) represented a relatively large capital commitment; 2) was placed in the avant-garde margin of the economy: modernised services and industry; 3) was not evenly spread over time. Circa the middle of the period under study (i.e. in 1872/3) there was a structural break, which opened a 'new phase': For, in the sub-period 1872/3-1909 as a whole, the count and registered capital of JSC start-ups were relatively higher and the sectoral composition was more diversified. There was a rise in industry and the near 'monoculture' of marine insurance within services gave way to a rise in other financial services (banks) and public goods, namely railways. In addition from 1872/3 onwards there was a specific continuity: peaks in incorporation were driven by banking capital.

Finally, we have shown that there was **coincidence** between the timing of the 1872/3 cut-off point and the other high level counts and 'exogenous' so to speak shocks/events (among which institutional /political changes, and or geographical expansion played a primary role). These acted so to speak as 'Kindlebergian' displacements which raised business expectations and increased investment in avant-garde activities (i.e. the nascent corporate sector). It could be argued that JSC founders seemed to prefer to ride a tide- their entrepreneurial drive being motivated by (and perhaps further feeding) 'rising expectations'.

Empirics complement the historical analysis and provide evidence in favor of **causality** between the meso-phenomenon of incorporation and macro-level indicators. We observe a structural break in the annual count of JSC births in 1872 as explained by agricultural GDP during 1840-1909. Considering a smaller sample based on years with non-missing capital records, there is evidence that JSC births are Granger-caused by GDP; causation is reciprocal in case of agricultural (and total) as opposed to non-agricultural GDP. This is one of our major contributions as it provides evidence of agricultural surplus transformation into modern services and industry, the transformation process being real capital investment using the JSC as the main business organization unit. Finally, in this respect, a co-integrating regression between the growth rates of JSC registered birth capital and agricultural GDP indicates that the latter tends to adjust at a rate of 2.5 times to long-run equilibrium, provided it exists.³² This last finding implies the presence of a ‘**virtuous circle**’ between incorporation, a meso-level process, and macro-economic growth: agricultural surplus provided the financial resources for incorporation, and the nascent ‘corporate sector’ enhanced the enlargement of the avant-garde margin in services and industry which in turn ‘pushed forward’ agricultural (and total) GDP.

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¹ A more recent example in this direction is: Andreas Colli and Fernandez Perez and Rose, 2003.

² This literature has taken a number of diverse directions, the main emphasis being on corporate governance issues and in particular for Britain and the USA. For example, see: Freeman, Pearson and Taylor, 2004 and Lamoreaux, 2009.

³ See also: Douglas Irwin and Richard Sylla, 2011.

⁴ In parallel to this new development some scholars working on the supply of entrepreneurship have turned to an examination of the interlinkages between firm

creation/start-ups (not necessarily of a JSC type however) and economic growth, See for example, Hausmann, 2006; Thurik and Wennekers, 1999; Foreman- Peck and Pepelasis, 2012; Pepelasis, 2010a.

⁵ For the concept of latecomer country, see: Gerschenkron, 1962.

⁶ For example: Karavas, 1930.

⁷ See for example: Dertilis, 2010; Dritsas, 1997; Hadziiossif, 1993; Kostis and Kostelenos, 2003; Vaxevanoglou, 1994.

⁸ A first effort in this direction is Pepelasis, 2011.

⁹ For a variety of indices of progress between 1880 and 1909, see also: Dertilis, 1977: 235-245.

¹⁰ Namely, the lands previously held by Ottomans and which had come into state 'ownership' following the War of Independence. See: Petmezas, 2003: 23-56; Franghiadis, 2007: 24-26.

¹¹ For the concept of the 1% benchmark defining the occurrence of 'modern economic growth', see: Irwin and Sylla, 2011.

¹² See: Resolution Z of 2 February 1828, *Efimeris tis Ellados*: pp. 38–39; Valaoritis, 1902:1–5.

¹³ Before, continuing, since here we have raised the legal issue let us note two developments in the wider legal context in the period under review: The first was the tax on distributed profits of JSC companies that was introduced in 1877. However, although this tax is estimated as yielding at least 5% of government revenue, it does not appear to have been a major drawback for JSC births, as the fifth peak in JSC births occurred shortly thereafter. (See above Text: Section 3.4.) The second development differed in that it was potentially positive for incorporation. It was the introduction of an inheritance tax in Greece in 1898, which in spite of its being less than 1% may have probably slightly increased the attraction of the JSC as a tax-avoiding device (Syrmaloglou, 2007: 216-227).

¹⁴ For more details on the topic of the ownership basis of JSCs and family capitalism in Greece, see Pepelasis, 2010, 2010a.

¹⁵ All the legal decrees for the founding of the 303 JSC start-ups were published in the *Greek Government Gazette*. Of the 251 founding charters used in our database, 228 were published in the *Greek Government Gazette*, 21 were discovered in the Notaries Association of Athens (in the archives of the 19th-century notaries: Ioannis Androulakis, Georgios and Ioannis Antoniadis, Gerasimos Afentakis, Antonios Bournias, Diogenis Diogeneidis, Ilias Glykofrydis, Georgios Gryparis, Stefanos Kondylis, Argyris Peppas, K. Pitaris), and 2 were in the General State Archives of Ermoupolis.

¹⁶ It should be noted that in many cases more than one purpose/sector was declared for each start-up. For reasons of analytical clarity in this paper, in those cases in which more than one purpose/sector was declared, we have taken into consideration only the first purpose/sector as we consider this to have been the main one.

¹⁷ On the basis of: the implicit deflator in Kostelenos et.al, 2007, and the exchange rates in Dertilis, 2010.

¹⁸ No compilation exists at a national level of the births of non-corporate firms which form historically the majority of enterprises in Greece. These types of firms were by law required to register at their local commercial court. A preliminary sample derived from the port of Ermoupolis on the Cycladic island of Syros reveals

the following information. Whereas in the year 1850 a total of 29 non-JSC firms/partnerships were established, for all of the decade of 1850 in the Cyclades, the total number of JSC births was only five (all in Ermoupolis). Furthermore, for four sample years in the 1890s (1890, 1893, 1894, 1895) a total of 24 non-JSCs/partnerships were created in the Cyclades, whereas for the whole of the 1890s there were only one JSC birth, again only in Ermoupolis. Source: Catalogue of the nominal commercial (non-JSC) firms in the islands of the Cyclades derived from the source: Companies 'Etairikon' 1837–1946 State Archives, Ermoupolis.

¹⁹ It would be interesting to explore why the partnership firms of a limited liability type, that is, the *société en commandité*, were far less frequent but at the moment a comprehensive set of data is not available.

²⁰ These findings fit the general observations on business start-ups of Thurik and Wennekers, 1999: 27–55.

²¹ For how the years 1872/3 were also a watershed in the geographic distribution of JSC births and the rise of interest in the public space, see Pepelasis, 2011a.

²² The median registered capital per JSC start-up was for the period as whole 34,480 pound sterling.

²³ The founding charters of 67 partnership-based firms established between 1903 and 1922 have been discovered at the Judicial Series of the National Bank of Greece. These were small companies in terms of registered capital. Twenty of these partnerships had a registered capital of fewer than 10,000 drachmas. Most were general partnerships, but the largest firm was the limited (liability) partnership 'Sklavounis and Simitis', which was established in Piraeus in 1908 and its registered capital was 388,889 drachmas (National Bank of Greece, Judicial Series A1, S40 Subseries 8, Legalisations, Files: 1235, 1246, 1315, 1440, 2421, 1443).

²⁴ No longer were public works/utilities in Greece constructed and run by Western-based JSCs start-ups, although there were some very few exceptions, such as: the Paris based 'Société Internationale du Canal Maritime de Corinthe' (1881) and the French and later British 'Lake Copais Co. Ltd' (1867) (Papayiannopoulou, 1989; Melios, 1987). In general for foreign investment in public utilities: see: Yiannitsis, 1977: 248-249.

²⁵ This moratorium was lifted in 1898 with the imposition of international financial supervision over Greece, and the country's renewed access to the international capital market.

²⁶ For the ways in which incorporation was linked to the rise of the bourgeoisie see: Pepelasis (2010a).

²⁷ During the 1872/3 peak, banking accounted for 60% of registered capital. For the 1882/3 peak, banking accounted for 18% of registered capital. (But let us note that in the previous year registered capital reached its all time high and 9/10 of this high was accounted for by banking.) In the 1893 peak, banking accounted for 64% of registered capital. Finally, in the 1907-1909 peak banking accounted for 5% of registered capital. This lower, but still significant on its own, share of banking can be interpreted as follows: Firstly, that the major innovation at the time in finance, i.e. the Postal Bank created in 1909 had no registered capital. Secondly, that the 1907/9 peak was the opening of a new period as regards the presence of banking in incorporation. The share of banking in total registered capital in the period 1909-1929 was only 11% vis-à-vis 52% for the period 1830-1909 (Pepelasis and Aivalis, 2012).

²⁸ Even though the histogram of JSC birth counts (Figure 1) suggests that the

highest in magnitude count of 39 births in 1873 is more of an outlier, empirical evidence supporting assertions 2 and 3, includes all three years 1871, 1872 and 1873 in the estimation sample, as these years are informative in terms of registered and paid-in capital (Figure 2 – Middle and bottom panels).

²⁹ This suspicion cannot be investigated any further, for instance using cluster analysis, as we are constrained by the nature of the data and the high concentration in certain sectors. Similar constraints have guided our choice of time series analysis. For instance, the lack of data at the firm level for at least two consecutive periods, prevent the use of micro-panel estimation.

³⁰ Agriculture was basically non-monetized with the exception of currants.

³¹ Even though, the rationale of cointegration assumes away the presence of a deterministic trend in the series, we may restrict our analysis to the stochastic trend component of the non-integrated process.

³² Formally speaking, the existence of such an equilibrium relationship should be accompanied by a formal mathematical proof derived on the basis of an underlying economic model. To our knowledge, there is no such economic model (linking gross incorporation to GDP growth) we could have relied on. Thus, we practically estimate our VEC model assuming such existence.

Table 1 - Selected macro indicators, benchmark years

Macro-indicators	1830	1870	1909
Territory (km ²)	47,516	50,211	63,201 ¹
Population	753,400 ²	1,457,894	2,631,952 ¹
Urban population	-	18%	28%
Literate population	-	18% ¹	33%
Share of non-agricultural sectors in GDP	19.6% ³	29.96%	36.31%
GDP (per capita in drachmas)	209.5 ⁴	207.6	285.3 ⁶
Exports plus imports (per capita in drachmas)	11 ⁷	130	122 ⁸
Monetary circulation (in million drachmas)	11.6 ⁹	64.8	171.6
Revenues from taxes (in million drachmas)	19 ¹⁰	35.7	110.4

¹Figure is for 1907.

²Figure is for 1828.

³Figure is for 1833.

⁴Figure is for 1832–1842.

⁵Figure is for 1863–1872.

⁶Figure is for 1903–1912.

⁷Figure is for 1851.

⁸Figure here is for 1908. It should be noted here that following the accession of the large region of Thessaly and Arta in 1881 a part of external trade became internal.

⁹Figure is for 1842.

¹⁰Figure is for 1833.

Sources: Compiled from Dertilis (2010) and Kostelenos et al. (2007).

Table 2 - Annual growth rate of GDP (%)

Decade	Total	Agricultural	Non-agricultural
1840	-0.6	-2.8	3.1
1850	4.0	4.5	-0.3
1860	2.0	0.9	5.8
1870	1.9	3.6	-0.6
1880	4.1	2.7	5.2
1890	0.6	-0.9	0.6
1900	2.3	3.0	2.6

Note: Reported are decade averages.

Table 3 - Conditions and important milestones in economy and society*

Socio-economic sphere	1830-1860	1860-1870	1870-1880	1880-1900	1900-1909
State formation	Obligatory primary education (1834) Creation of the National Bank of Greece (1841)	Accession of Ionian islands (1864)	Intensification of centralisation of state machinery	Accession of Thessaly and Arta (1881) Construction of public works under French Naval Mission (1884–1890)	
Political sphere	Absolutist Monarchy (1832/3) Constitutional Monarchy (1844)	Royal Republic Universal franchise (1864)	Introduction of principle of Parliamentary majority (1875)	Rise of collective action	Goudi Uprising (1909)
Legal sphere	Byzantine Hexabiblos basis for civil code		Draft of French/Italian/Saxon inspired Civil Code (1874)	German Civil Code as point of reference	
Fiscal sphere	Ottoman system of taxation (Tithes and tax pharming) Budgetary arbitrariness		Tax on profits of JSCs (1877) Tithe is abolished (1881)	Imposition of International Financial Control (1898) Introduction of inheritance tax (1898)	
Property rights	Predominance of customary law State holds extensive tracts of land No property rights for peasants		Distribution of national lands Property rights for peasants (1871)		

*The period under review has been divided into five sub-periods. The length of each sub-period is determined by the richness/wealth of events. For example, the first is the longest as it was not so rich in the number of structural changes.

Sources: Clogg (1992); Dacoronia (2003); Dertilis (2010); Kostis (2005).

Table 4 - Summary statistics of JSC births and real capital by decade (in 000s Drs)

Decade	Variable	Sum	Capital ratio	Min.	Max.	Range	Mean	Median	Stand. Dev.	# Firms
1840	Registered capital	14,362	<i>38:1</i>	90	9,728	9,639	3,590	2,272	4,422	4
	Paid capital	375		375	375	0	375	375	.	1
	# Births	12								
1850	Registered capital	20,331	<i>2.5:1</i>	339	3,533	3,194	1,848	1,598	1,323	11
	Paid capital	8,167		85	1,686	1,601	742	821	541	11
	# Births	12		.	.	.	.	.	.
1860	Registered capital	59,159	<i>4:1</i>	49	7,851	7,801	1,345	887	1,505	44
	Paid capital	14,380		7	1,514	1,507	327	341	262	44
	# Births	46								
1870	Registered capital	179,704	<i>24:1</i>	9	36,232	36,223	3,667	1,090	7,611	49
	Paid capital	7,464		7	3,121	3,114	415	157	737	18
	# Births	76								
1880	Registered capital	502,747	<i>49:1</i>	68	328,912	328,844	17,955	2,409	61,874	28
	Paid capital	10,253		210	5,392	5,181	2,051	1,078	2,192	5
	# Births	42								
1890	Registered capital	69,429	<i>11:1</i>	21	16,957	16,936	3,654	1,329	4,947	19
	Paid capital	6,530		1	2,441	2,440	816	459	988	8
	# Births	29								
1900	Registered capital	211,929	<i>2:1</i>	23	38,519	38,495	3,260	962	6,354	65
	Paid capital	121,648		2	28,889	28,886	2,385	526	4,839	51
	# Births	77								
Total	Registered capital	1,057,662	<i>6:1</i>	9	328,912	328,904	4,808	1,084	22,921	220
	Paid capital	168,817		1	28,889	28,888	1,223	356	3,123	138
	# Births	294								

Note: Based on all 294 firms observed in the period 1840-1909. The capital ratio is defined as the ratio of registered to paid capital over a certain decade; ratios in Italics emphasize the unequal number of capital records available intra-decade.

Table 5a - Summary statistics of JSC births and real registered capital by decade and sector (in 000s Drs)

REAL REGISTERED CAPITAL		Agriculture	Insurance	Banking	Commerce	Maritime transports	Land transport (railways)	Other financial	Other services	Mining	Manufacturing	Construction	Public utilities	Self-help associations	Total
1840s	# Births	.	9	2	.	.	.	.	.	.	.	1	.	.	12
	Frequency	.	1	2	.	.	.	.	.	.	.	1	.	.	4
	Sum	.	653	13,620	.	.	.	.	.	.	.	90	.	.	14,363
	Mean	.	653	6,810	.	.	.	.	.	.	.	90	.	.	.
	Median	.	653	6,810	.	.	.	.	.	.	.	90	.	.	.
1850s	# Births	.	10	.	.	1	.	.	.	.	1	.	.	.	12
	Frequency	.	9	.	.	1	.	.	.	.	1	.	.	.	11
	Sum	.	13,484	.	.	3,533	.	.	.	.	3,315	.	.	.	20,332
	Mean	.	1,498	.	.	3,533	.	.	.	.	3,315	.	.	.	.
	Median	.	1,178	.	.	3,533	.	.	.	.	3,315	.	.	.	.
1860s	# Births	.	31	4	3	1	1	.	1	1	1	2	1	.	46
	Frequency	.	31	3	3	1	1	.	.	1	1	2	1	.	44
	Sum	.	47,602	6,705	3,431	91	176	.	.	710	91	301	52	.	59,159
	Mean	.	1,536	2,235	1,144	91	176	.	.	710	91	150	52	.	.
	Median	.	1,297	2,201	418	91	176	.	.	710	91	150	52	.	.
1870s	# Births	1	4	11	2	3	.	4	1	29	17	1	2	1	76
	Frequency	.	1	9	1	1	.	1	.	25	8	1	2	.	49
	Sum	.	5,276	102,723	52	1,178	.	2,355	.	58,718	6,725	589	2,089	.	179,705
	Mean	.	5,276	11,414	52	1,178	.	2,355	.	2,349	841	589	1,045	.	.
	Median	.	5,276	7,066	52	1,178	.	2,355	.	1,014	467	589	1,045	.	.
1880s	# Births	.	3	3	2	2	6	1	2	2	9	4	1	7	42
	Frequency	.	1	3	2	2	6	1	.	2	7	4	.	.	28
	Sum	.	1,119	361,666	13,612	10,679	93,315	356	.	4,914	3,572	13,515	.	.	502,748
	Mean	.	1,119	120,555	6,806	5,339	15,552	356	.	2,457	510	3,379	.	.	.
	Median	.	1,119	21,566	6,806	5,339	5,871	356	.	2,457	436	3,713	.	.	.
1890s	# Births	.	1	4	2	1	3	1	1	2	7	1	.	6	29
	Frequency	.	1	2	1	1	3	.	1	2	7	1	.	.	19
	Sum	.	6,755	25,818	49	1,241	20,606	.	1,329	4,330	3,489	5,814	.	.	69,431
	Mean	.	6,755	12,909	49	1,241	6,869	.	1,329	2,165	498	5,814	.	.	.
	Median	.	6,755	12,909	49	1,241	3,122	.	1,329	2,165	203	5,814	.	.	.
1900s	# Births	3	5	9	10	8	1	.	3	13	14	4	3	4	77
	Frequency	2	3	6	10	7	1	.	3	12	14	4	3	.	65
	Sum	2,700	11,003	39,335	41,493	36,138	9,227	.	17,884	14,590	13,992	4,166	21,401	.	211,929
	Mean	1,350	3,668	6,556	4,149	5,163	9,227	.	5,961	1,216	999	1,042	7,134	.	.
	Median	1,350	2,034	4,822	295	2,353	9,227	.	302	1,029	504	1,019	1,078	.	.
Total	# Births	4	63	33	19	16	11	6	8	47	49	13	7	18	294
	Frequency	2	47	25	17	13	11	2	4	42	38	13	6	.	220
	Sum	2,700	85,892	549,867	58,637	52,860	123,324	2,711	19,213	83,262	31,184	24,475	23,542	.	1,057,667

Note: Based on all 294 firms observed in the period 1840-1909. No capital reported for the 18 self-help associations. Slight discrepancies in the decade total compared to table 4 are owed to rounding.

Table 5b - Summary statistics of JSC births and real paid capital by decade and sector (in 000s Drs)

REAL PAID CAPITAL		Agriculture	Insurance	Banking	Commerce	Maritime transports	Land transport (railways)	Other financial	Other services	Mining	Manufacturing	Construction	Public utilities	Self-help associations	Total
1840s	# Births	.	9	2	.	.	.	.	.	.	.	.	1	.	12
	Frequency	.	1	.	.	.	.	.	.	.	.	.	.	.	1
	Sum	.	375	.	.	.	.	.	.	.	.	.	.	.	375
	Mean	.	375	.	.	.	.	.	.	.	.	.	.	.	.
	Median	.	375	.	.	.	.	.	.	.	.	.	.	.	.
1850s	# Births	.	10	.	.	1	.	.	.	.	.	1	.	.	12
	Frequency	.	9	.	.	1	.	.	.	.	.	1	.	.	11
	Sum	.	6,661	.	.	1,289	.	.	.	.	.	217	.	.	8,167
	Mean	.	740	.	.	1,289	.	.	.	.	.	217	.	.	.
	Median	.	821	.	.	1,289	.	.	.	.	.	217	.	.	.
1860s	# Births	.	31	4	3	1	1	.	.	1	1	1	2	1	46
	Frequency	.	31	3	3	1	1	.	.	.	1	1	2	1	44
	Sum	.	13,302	545	59	54	36	.	.	.	14	91	231	47	14,379
	Mean	.	429	182	20	54	36	.	.	.	14	91	115	47	.
	Median	.	381	88	24	54	36	.	.	.	14	91	115	47	.
1870s	# Births	1	4	11	2	3	.	1	4	1	29	17	1	2	76
	Frequency	.	1	2	.	1	1	.	1	.	9	3	1	.	18
	Sum	.	1,145	103	.	91	.	.	181	.	4,489	924	531	.	7,464
	Mean	.	1,145	52	.	91	.	.	181	.	499	308	531	.	.
	Median	.	1,145	52	.	91	.	.	181	.	137	210	531	.	.
1880s	# Births	.	3	3	2	2	6	7	1	2	2	9	4	1	42
	Frequency	.	.	.	.	.	.	.	.	.	1	2	2	.	5
	Sum	.	.	.	.	.	.	.	.	.	3,125	658	6,470	.	10,253
	Mean	.	.	.	.	.	.	.	.	.	3,125	329	3,235	.	.
	Median	.	.	.	.	.	.	.	.	.	3,125	329	3,235	.	.
1890s	# Births	.	1	4	2	1	3	6	1	1	2	7	1	.	29
	Frequency	.	.	1	.	1	.	1	.	.	1	4	.	.	8
	Sum	.	.	2,215	.	889	.	1	.	.	2,441	984	.	.	6,530
	Mean	.	.	2,215	.	889	.	1	.	.	2,441	246	.	.	.
	Median	.	.	2,215	.	889	.	1	.	.	2,441	147	.	.	.
1900s	# Births	3	5	9	10	8	1	4	.	3	13	14	4	3	77
	Frequency	2	3	5	6	6	.	.	.	2	11	10	3	3	51
	Sum	642	9,933	26,272	29,648	17,622	.	.	.	8,766	6,322	10,449	1,616	10,377	121,647
	Mean	321	3,311	5,254	4,941	2,937	.	.	.	4,383	575	1,045	539	3,459	.
	Median	321	1,017	4,432	154	1,941	.	.	.	4,383	610	350	481	216	.
Total	# Births	4	63	33	19	16	11	18	6	8	47	49	13	7	294
	Frequency	2	45	11	9	10	1	1	1	2	23	21	8	4	138
	Sum	642	31,416	29,135	29,707	19,945	36	1	181	8,766	16,391	13,323	8,848	10,424	168,815

Note: Based on all 294 firms observed in the period 1840-1909. No capital reported for the 18 self-help associations. Slight discrepancies in the decade total compared to table 4 are owed to rounding.

Table 6 - Real capital during peak year(s) in JSC births

Peak year(s)	Variable	Sum	# Firms
1860	Registered capital	14,114.6	8
	Paid capital	2,628.4	8
	# Births	.	8
1862	Registered capital	23,146.7	10
	Paid capital	3,214.9	10
	# Births	.	10
1866	Registered capital	4,202.6	8
	Paid capital	1,698.6	8
	# Births	.	8
1872-3	Registered capital	172,015.6	55
	Paid capital	6,003.1	55
	# Births	.	55
* 1881	Registered capital	341,118.7	5
	Paid capital	3,572.5	5
	# Births	.	5
1882-3	Registered capital	124,967.4	19
	Paid capital	6,680.2	19
	# Births	.	19
1893	Registered capital	13,933	12
	Paid capital	3,793.9	12
	# Births	.	12
1907-9	Registered capital	114,275.6	40
	Paid capital	59,731.7	40
	# Births	.	40
Total	Registered capital	807,774.4	157
	Paid capital	87,323.3	157
	# Births	.	157

Note: Reported capital values are year-sums in 000s Drs.

* 1881 has been included in Table 6 as it is the all-time peak in registered capital.

Table 7 - Structural break in JSC birth counts (y. 1872)

Model		Poisson			NB
Variable		1840-1871	1872-1909	1840-1909	1840-1909
LRAGDP	Estimate	1.902	-0.801	0.936	1.154
	St. Error	0.469	0.354	0.151	0.297
	p-value	0.000	0.024	0.000	0.000
Constant	Estimate	-34.365	17.124	-16.303	-20.419
	St. Error	8.723	6.789	2.880	5.631
	p-value	0.000	0.012	0.000	0.000
	Alpha			-	0.931
	St. Error			-	0.281
	Pseudo-R ²	11.48%	1.46%	7.67%	3.06%
	LnPL value	-68.46	-169.82	-253.29	-173.33

Note: Dependent variable is the annual (time series) count of JSC births. Robust estimation, based on 70 observations over the period 1840-1909. LRAGDP indicates log-real agricultural GDP. NB = Negative Binomial.

Structural break test (pooled vs. nested)

The LR diagnostic test is positive for a structural break in 1872:

LR χ^2 -value = 30.01 with p-value=0.000.

Table 8 - Structural VAR(1) estimates and Granger causality tests*LCOUNT and LRGDP equations*

	Estimate	St. Error	p-value
α_{11}	1.2905	0.1589	0.000
α_{12}	(omitted)		
α_{21}	0.1195	0.2251	0.600
α_{22}	11.6839	1.4382	0.000
LnL value	-4.112		

Equation	Causal	F-statistic	p-value	df_r
LCOUNT	LRGDP	4.8306	0.036	30
LRGDP	LCOUNT	5.8683	0.022	30

LCOUNT and LRNAGDP equations

	Estimate	St. Error	p-value
α_{11}	1.2688	0.1562	0.000
α_{12}	(omitted)		
α_{21}	-0.1402	0.2215	0.532
α_{22}	3.7556	0.4623	0.000
LnL value	-42.126		

Equation	Causal	F-statistic	p-value	df_r
LCOUNT	LRNAGDP	3.6677	0.065	30
LRNAGDP	LCOUNT	1.5357	0.225	30

LCOUNT and LLAGDP equations

	Estimate	St. Error	p-value
α_{11}	1.3154	0.1619	0.000
α_{12}	(omitted)		
α_{21}	0.2090	0.2304	0.372
α_{22}	9.0668	1.1160	0.000
LnL value	-11.852		

Equation	Causal	F-statistic	p-value	df_r
LCOUNT	LLAGDP	6.1837	0.019	30
LLAGDP	LCOUNT	12.331	0.001	30

Note: The models are exactly identified. Parameter restrictions: $\alpha_{12} = 0.0$, $\beta_{11} = \beta_{22} = 1.0$, $b_{12} = b_{21} = 0.0$ (ones are not identified). Based on 34 (33 in estimation) time series observations for years with non-missing registered and paid capital, namely: 1849 1854 1856-1862 1864-1873 1881-1882 1893-1894 1899-1909.

Abbreviations:

LCOUNT The log-count of JSC births
(logs adjusted for zero log-values)

GDP GDP (in Drs)

NAGDP Non-agricultural GDP (in Drs)

AGDP Agricultural GDP (in Drs)

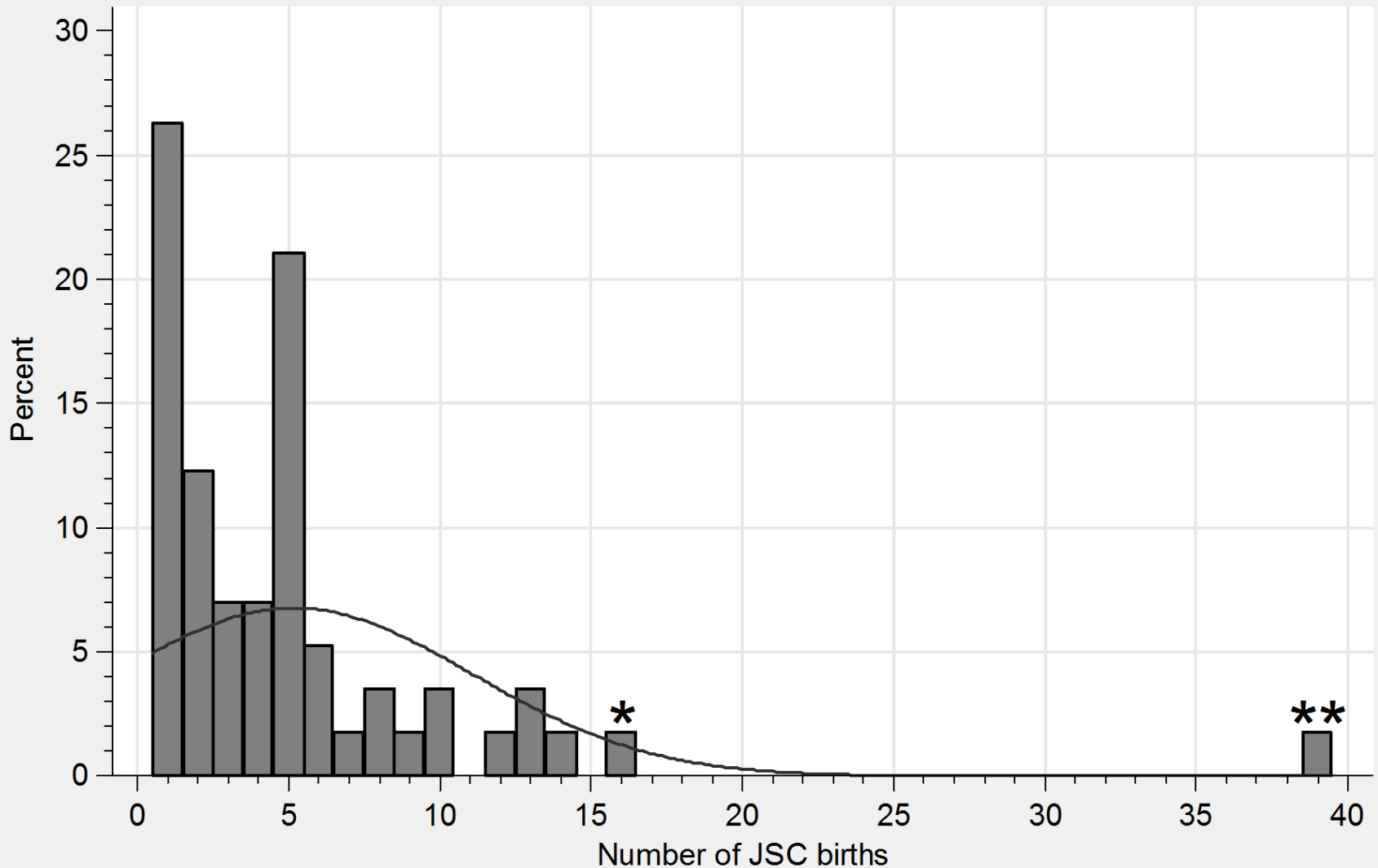
LR Log-real

Table 9 - Vector Error Correction Model (VECM) estimation results

						<i>by equation</i>	
Estimates using registered capital (log-real)					Propensity	R²	χ² (Pr>χ²)
$\begin{pmatrix} \text{D.LRNCAP} \\ \text{D.LRGDP} \end{pmatrix} = \begin{pmatrix} \hat{c}_1 \\ \hat{c}_2 \end{pmatrix} + \begin{pmatrix} -0.7390^{***} & 1.2136^{***} \\ (0.1780) & (0.2923) \end{pmatrix} \begin{pmatrix} \text{L1.LRNCAP} \\ \text{L1.LRGDP} \end{pmatrix}$	→	<i>Unit root</i>	35.93%	17.3844	0.0002		
	→	-1.6422 *	28.69%	12.4698	0.0020		
<i>Growth rates (log-differences)</i>		$\Pi \equiv A-I$		<i>Log-real levels lagged once</i>			
$\begin{pmatrix} \text{D.LRNCAP} \\ \text{D.LRAGDP} \end{pmatrix} = \begin{pmatrix} \hat{c}_1 \\ \hat{c}_2 \end{pmatrix} + \begin{pmatrix} -0.7216^{***} & 1.8491^{***} \\ (0.1727) & (0.4424) \end{pmatrix} \begin{pmatrix} \text{L1.LRNCAP} \\ \text{L1.LRAGDP} \end{pmatrix}$	→	<i>Unit root</i>	36.23%	17.6130	0.0001		
	→	-2.5626 **	32.04%	14.6139	0.0007		
Estimates using paid capital (log-real)					Propensity	R²	χ² (Pr>χ²)
$\begin{pmatrix} \text{D.LRPCAP} \\ \text{D.LRGDP} \end{pmatrix} = \begin{pmatrix} \hat{c}_1 \\ \hat{c}_2 \end{pmatrix} + \begin{pmatrix} -0.8811^{***} & 1.3208^{***} \\ (0.1796) & (0.2693) \end{pmatrix} \begin{pmatrix} \text{L1.LRPCAP} \\ \text{L1.LRGDP} \end{pmatrix}$	→	<i>Unit root</i>	43.81%	24.1653	0.0000		
	→	-1.4990 †	29.96%	13.2622	0.0013		
$\begin{pmatrix} \text{D.LRPCAP} \\ \text{D.LRAGDP} \end{pmatrix} = \begin{pmatrix} \hat{c}_1 \\ \hat{c}_2 \end{pmatrix} + \begin{pmatrix} -0.8660^{***} & 1.7503^{***} \\ (0.1801) & (0.3639) \end{pmatrix} \begin{pmatrix} \text{L1.LRPCAP} \\ \text{L1.LRAGDP} \end{pmatrix}$	→	<i>Unit root</i>	23.80%	23.2380	0.0000		
	→	-2.0211 ‡	6.71%	6.7069	0.0350		

Note: The model is exactly identified (i.e. the restricted rank of matrix Π equals 1) based on Johansens' TRACE statistic (not reported here). Estimation is based on 33 (out of 34) time series observations for years with non-missing registered and paid capital, namely: 1849 1854 1856-1862 1864-1873 1881-1882 1893-1894 1899-1909. Standard errors in brackets. † p<0.10, ‡ p<0.05, * p<0.01, ** p<0.005, *** p<0.001. The long-run propensity to adjust (impact parameter θ^{\wedge}) is derived on the basis of the corresponding cointegrating vector.

Figure 1 - Histogram of JSC counts by birth year



Histogram plotted against the normal density.

* 16 births in 1872 (2nd highest, extreme event). ** 39 births in 1873 (highest, outlier).

Based on 294 firms observed during 1840-1909 of which 18 self-help associations.

Figure 2 - JSC births and real capital series

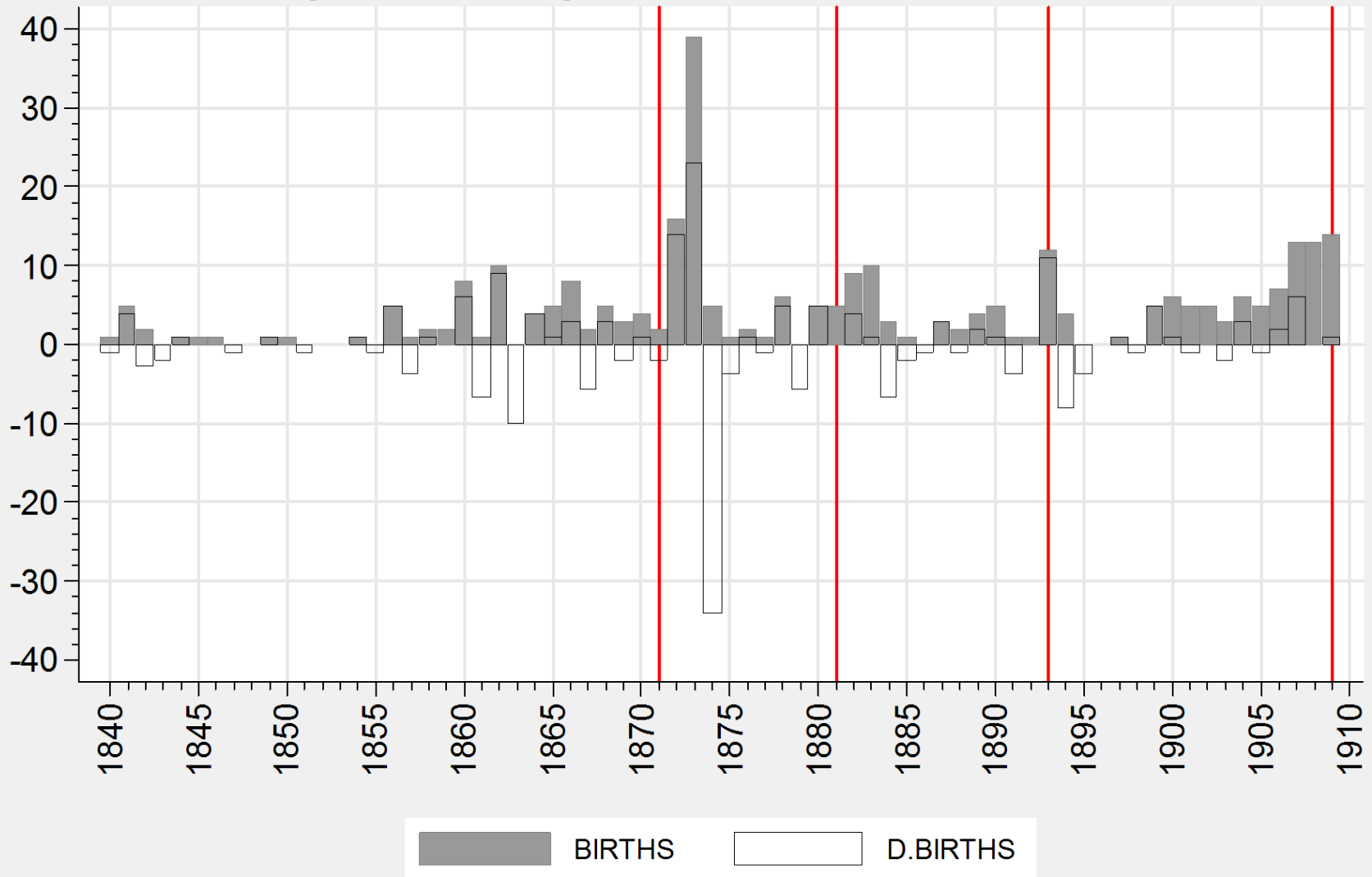


Top-bottom: Births, real registered and paid capital (year-sums in Million Drs).

Based on 70 time series observations observed annually during 1840-1909.

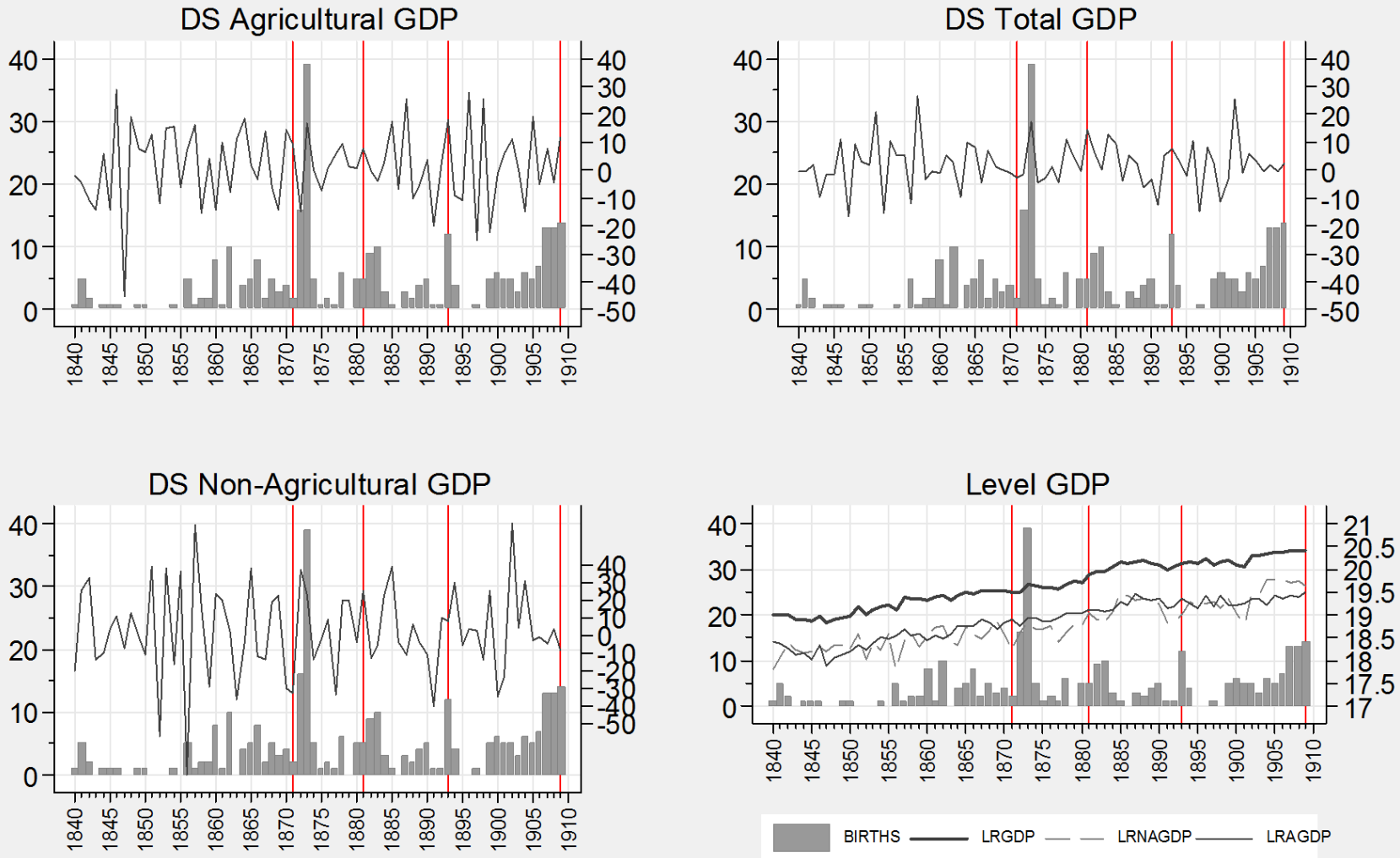
Big events: 1871 Agricultural reform, 1881 Thessaly/Loans, 1893 Currant crisis/Default, 1909 Goudi.

Figure 3 - Changes in the JSC births series



Based on 70 time series observations observed annually during 1840-1909.
Plotted actual versus stationary series (first differences of log-counts adjusted for zero log-values).
Big events: 1871 Agricultural reform, 1881 Thessaly/Loans, 1893 Currant crisis/Default, 1909 Goudi.

Figure 4 - The JSC births and real GDP series



The levels are in log-real terms; the DS series are annual growth rates (%).
 Based on 70 time series observations observed annually during 1840-1909.
 Big events: 1871 Agricultural reform, 1881 Thessaly/Loans, 1893 Currant crisis/Default, 1909 Goudi.