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AT THE ONSET OF THE ORIGINAL CAPITAL ACCUMULATION

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Mauro Rota - Luca Spinesi

At the Onset of the Original Capital Accumulation

Mauro Rota *and Luca Spinesi †

July 20, 2013

Abstract

The historical data show that the early modern period in Great Britain paved the way to the classical industrial revolution presenting the first phase of capital accumulation and rise in per capita income. This paper captures the relevant evidence by means of a stylized model describing two engines determining this economic process: the role of the guilds in the manufacturing industry and proto-industrialization. On the evidence of the historical facts, we show that the process of capital accumulation was driven by a class of capitalists, the entrepreneurs-merchants, who shifted manufacturing production to the countryside in order to escape from the guilds' market power in urban environments. In the countryside entrepreneurs-merchants increased their rate of profit, triggering capital accumulation by exploiting cheaper labour costs and the re-allocation of working time from agricultural to manufacturing activity. Finally, we show that the model corresponds to the pattern of historical data on manufacturing production and capital accumulation from the 14th century to the rise of the classical industrial revolution.

Keywords: original capital accumulation, guilds, merchants, proto-industry.

JEL Classification: N130, N630, O100, O140

Gigni de nihilo nihilum, in nihilum nil posse reverti (Persio, Satira III, v. 83-84)

1 Introduction

The sustained economic growth of the Western European economy as from 1750 is a topic that has attracted the attention of both growth economists and economic historians. The literature has emphasized different factors accounting

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for the take-off, such as technology (Mokyr 2002), human capital accumulation (Galor and Moav 2004) and institutions (Acemoglu et al. 2005, Acemoglu 2008, North 1990), to mention but a few.

In search of possible explanations for the take-off of the Western countries the old school of development economists advanced the idea that a preliminary phase of physical capital accumulation allowed for growth in the manufacturing sector, increased demand for labour and the implementation of new technologies, all of which made the take-off possible (Gerschenkron 1962, Rostow 1959). Thus, an early phase of physical capital accumulation is a central issue if we are to understand the long run evolution of Europe from the Malthusian regime to sustained growth [1]. Moreover, original capital accumulation is associated with an early rise in per capita GDP, crucial for transition to self-sustained growth (Galor and Weil 2000, Hansen and Prescott 2002, Voigtlander and Voth 2006). This is not to say that capital accumulation is a sufficient condition for modern sustained growth. We are aware of the importance of the institutional set-up and its interactions with other factors, such as Atlantic expansion. With this paper we intend to offer a complementary explanation of the great drive of a leading economy.

We focus on the economic history of Great Britain which first industrialized and experienced sustained economic growth. We argue that the original capital accumulation and subsequent increase in manufacturing production since around the 15th Century came from the major transformations coming about in production methods [2].

At the beginning of this period manufacturing production was concentrated in the towns and governed by the merchants Guilds (Ogilvie 1997, 2011) [3]. The guilds imposed high production costs in towns where their rules and regulations were effective in regulating the manufacturing production. As a response, to save on production costs the entrepreneurs-merchants (simply merchants hereafter) began to move their manufacturing production from towns to the countryside, where enforcement of the Guilds' rule proved ineffective. This new type of organization of industrial production outside the towns is known as proto-industry or the putting-out-system, pointed out as one of the most important germs for capital accumulation (Mendels 1972). In the countryside, workers typically divided their labour time between agriculture and manufacturing according to their relative productivities. Wages paid by merchants to workers in the countryside were cheaper than wages paid in town because of the supplemental wage earned in the agricultural sector. By moving a share of the manufacturing pro-

[1] The dynamism of the Western economy during the early modern period is now a well-established evidence in the economic history literature (North and Thomas 1973, Van Zanden 2009).

[2] We are aware that the concept of original capital accumulation refers also to the accumulation of capitals in the agricultural sector which flowed in the manufacturing industry easing the industrial revolution (Jones 1988). Even if we look at the accumulation of capital in the manufacturing sector of the early modern period, possible accumulation in agriculture does not invalidate our results, quite they are strengthened as we discuss in section 4.1.

[3] In the rest of Europe the Craft Guilds dominated the manufacturing production and lasted until the late XVIII century.

duction to the countryside, merchants boosted their rates of profit, triggering capital accumulation in the manufacturing sector. In modelling this process we take the textile sector for two reasons. First, the textile industry was at the core of what was to become the industrial revolution. Secondly, the delocalization process mainly affected the textile productions of low and medium quality. High quality goods continued to be produced in the urban centres while the iron industry was at that time already located outside the towns for technological reasons. Thus, in our set-up we endogenously derive the underlying mechanisms which allowed for the transfer of workers from town to country, and for the allocation of working time between agricultural and manufacturing activities in the country.

We show that our model captures the pattern of production in manufacturing industry in the period between the 15th and 18th centuries, as reconstructed by Broadberry et al. (2011). They provide historical evidence that the British economy escaped the Malthusian trap even before the Industrial revolution. Our findings support this evidence and offer a possible explanation of an early increase in manufacturing production driven by physical capital accumulation. We assume technological progress to be negligible in the manufacturing sector, as it had been in pre-industrial times (Acemoglu 2008, Aiyar et al. 2008, Galor 2005, Mokyr 2002). Moreover, at the beginning of the 18th century the key technology of the steam engines was not so widespread throughout the British counties (Nuvolari et al. 2011). For this reason, the early increase in manufacturing production before the classical industrial revolution was mainly driven by capital accumulation.

Moreover, our theory of capital accumulation is related to the economic growth literature. So far the literature has focused on the mechanisms underlying the transition from the post-Malthusian regime to the sustained growth model where technological progress interacts with human capital formation, eventually triggering acceleration in technological advances, the demographic transition and the sustained growth regime (Galor and Moav 2004, Galor 2005, Peretto 2012). We contribute to the debate by introducing the phase of original capital accumulation representing the transition from feudal times to the early capitalistic production system. We are not the first to treat the preconditions for self-sustained growth. Before us Voigtlander and Voth (2012) had argued that external shocks in population size triggered an early rise in per capita income in Europe. However, we are the first to seek an endogenous explanation of the rise in income per capita caused by the behaviour of a class of capitalists, namely the merchants. What we do not do is to build a model generally employable for Europe as a whole. In fact, we model the economic framework of early modern England which was in several respects different from continental Europe. The decline of the guilds in England was an exception in Europe, and only the Low Countries are found to have experienced something similar (Ogilvie 2011).

The rest of the paper is organized as follows. The historical background to the British economy is provided in section 2. Section 3 presents the theoretical model. Section 4 derives the market clearing conditions, while section 5 shows how our model fits in with the most recent historical data and evidence

of manufacturing production and real wages. Section 6 concludes.

2 The Historical Background

In the early phase of capital accumulation the individual entrepreneurs, the merchants, played a pivotal role (Dobb 1946). In fact, merchants across Europe invested capital in a wide range of assets as well as in manufacturing production. Since about 1500 interest rates in Europe had fallen dramatically (Clark 1988 and 2007, Epstein 2000), but different areas reacted in different ways. In southern Europe merchants from Florence Venice and Genoa made profits through long-distance trade with the Far East. As the rates of profits decreased, Venetian merchants invested in alternative sectors, such as real estate. In Genoa and Florence, the local merchants responded to the decreasing rates of profit by lending accumulated capital to the central governments and monarchs. In Great Britain, on average merchants found it profitable to invest in the manufacturing sector.

We are certainly not claiming that in other parts of Europe no capital was invested in manufacturing. However, from the historical data we can argue that investments in the manufacturing production prevailed over other kinds of assets in the case of England. One possible reason was the relative backwardness of the British financial markets. Another possible reason is that the cost of capital in England fell much more than in the rest of Europe (Epstein 2000).

Until the late 15th century the manufacturing industry in Great Britain was largely concentrated in the urban centres and dominated by the presence of the Guilds, which controlled industrial production, establishing rules for its members. In the manufacturing sector, the historical literature distinguishes between crafts and merchants guilds. The former prevailed in continental Europe while the latter were much more important in England (Ogilvie 2011). The guilds behaved in a monopolistic way by imposing inputs prices and the quantity of workers employed, as well as determining the rent of land inside the urban centres and performing various other tasks in the economic and social life of early modern cities (Epstein 1998, Ogilvie 1997) [4]. Moreover, the guilds regulated access to membership, which was very often restricted with a set of requisites such as citizenship and wealth endowment. The guilds evolution varied across the European countries, and England systematically departed from the continental pattern, with the exception of the Low Countries. Thus, the English merchants guilds gradually began to decline after about the 16th century (Ogilvie 2011) [5], the potential reasons being the density of the urban centres and the political competition between cities, which made it difficult to enforce local privileges guaranteed by the urban guilds. Hence, in the British countryside no single

[4] The above-mentioned contributions are in sharp contrast on the role of guilds in generating welfare. However, we will not enter into the debate on the efficiency of guilds as representative institutions of the early modern period because what matters in our story is that the costs of production could be lower outside the urban centres because of the absence of the guilds.

[5] Only private merchant companies for very long-distance trade, especially colonial trade, survived.

town could thoroughly implement its guilds regulation because other merchants from different towns claimed the opportunity to trade there (Ogilvie 2011, p. 32).
Once the population began to grow the market potentially expanded, yet the market power exerted by the guilds in principle hampered opportunities to take advantage of the market expansion. As a consequence, the merchants moved production to the countryside, where the guilds enforcement was ineffective and the cost of labour was lower than in the towns (Hicks 1969, Kellenbez 1977). The delocalization process applied to the textiles sector and the low- and medium-quality productions in that industry. This turned out to be of great importance, for the leading sectors of the classical industrial revolution were the cotton and wool industry. The high-quality and luxury productions continued to be located in the urban centres because of the quality control of production. Moreover, when observing the delocalization process we do not consider the iron industry, that particular production being located, in the early modern period, in the countryside for technological reasons.
As for the textile industry, the shift of production allowed merchants to benefit from the production system in the countryside known as proto-industry (Mendels 1972). Protoindustrialization refers to the system of domestic industrial production in place in Europe from the end of 16th century to produce for non-local markets (Mendels 1972). The merchants activities had been associated with protoindustrialization in early modern Europe to account for four big changes in the economic framework: population growth, entrepreneurial behaviour, capital accumulation and creation of the workforce for future factory industrialization. We will concentrate on capital accumulation above all in the light of the spate of criticism levelled at the alleged role of proto-industry in shaping the future development of capitalist industry (Ogilvie 1993). Comparative studies have clarified that proto-industry was neither a sufficient nor necessary condition for factory industrialization and that many cases of success depended upon the specific institutions which interacted with protoindustrialization. We will not enter into the debate as to whether protoindustry influenced factory industrialization, but we will consider its role in favouring capital accumulation and the connections with the merchants guilds.
Protoindustrialization and the associated putting-out-system were founded upon households situated in the countryside and working in both the agricultural and manufacturing sectors. Indeed, the households of the early modern period drew their income from labour in the agricultural sector and very often supplemented it by supplying labour for the manufacturing industry located in the countryside. They usually drew their share of agricultural income from the common lands or small plots of land, where they produced agricultural goods for self-consumption. This holds despite the diffusion of the agrarian capitalism. In northern England family farms were still more important than labour farms until after the year 1700, and only by the middle of the nineteenth century had labour-employing farms become more important (Shawn-Taylor 2011). As a fraction of income came from production for self-consumption the workers in rural areas accepted wages for manufacturing production lower than those paid

in the urban centres. This was also feasible because of the institutions governing land ownership in early modern England. Outside the landlords real estates, land was almost free as long as the open field institutions survived. The open field institutions comprised rights of ploughing and livestock grazing, among others. The inhabitants of the countryside lost their rights over the open fields when enclosure was enforced. Although the enclosure of open fields had begun in the early of 16th century it only proliferated in the 18th century, when the British Parliament allowed for local enclosure with the Enclosures Acts. For these reasons we can safely assume that lands were sufficiently available outside the landlords real estates, at least in the period under scrutiny in this paper [6]. Since the typical households in the putting-out-system divided their working time between manufacturing production and agriculture for self-consumption, the merchants paid a lower wage rate to hire labour in manufacturing production. As a result, the rate of profit fostered production in the countryside, allowing capital accumulation to be sustained. We assume, as the historical evidence confirms, that the typical country households supplied labour to guarantee the subsistence of the family. Hence, they were more interested in the allocation of their labour time between manufacturing and agricultural activities than in maximising their total labour time (Kriedte et al. 1981, and Kriedte 1983).

The process of capital accumulation of the merchants was further reinforced by the increase in the number of working days. Generally, in the decades before the upsurge of the Classical Industrial Revolution, populations living in the countryside had a greater number of working days because of the reduction of religious holidays (Allen and Weisdorf 2011) made in the reformed lands. One implication was that as long as the working days increased, capital accumulation proceeded in order to keep the capital labour ratio consistent with the aggregate output (Acemoglu 2008, Aiyar et al. 2008, Galor 2005, Mokyr 2002). We abstract from such institutional aspects Yet, considering such elements both the model's predictions and results would strengthen. We formalize the set-up of British economy in the next section.

2.1 Population

We consider an overlapping-generation model with bequests where individuals live for two periods. At each date $t \geq 0$ the total population N is divided in two groups or classes: workers w and merchants m. The population is assumed to be constant over time [7]. Workers can live either in town or in the countryside. In

[6] Clark and Clark (2001) argue that much of the free lands were available under the rules of the community and that common land free to the poor accounted for a very small share of arable land by 1600. This contribution does not alter our hypothesis because we are considering the rights on the land available to the members of the community rather than to poor individuals.

[7] The assumption of constant population is made to simplify exposition. All the results are reinforced considering a population growing at a constant and exogenous rate $n > 0$. As the main focus of the paper is on capital accumulation in the manufacturing industry, we abstract from individuals' optimal choices on offspring and educational attainments.

accordance with the historical evidence, land is assumed to be free, so that any individual living and working in the countryside faces neither land constraint nor land cost. To fix ideas, we refer to lands outside the landlords areas and the extensive farmland. Workers living in town will be employed in manufacturing activity only, while workers living in the countryside can be employed in both the agricultural and the manufacturing sectors. The merchants own capital which is employed in manufacturing activity, which can take place both in town and in the countryside.

2.2 Preferences

In the first period of life individuals are born with one unit of labour that they supply inelastically. Workers are assumed to receive no bequest, so that each worker spends her own income in consumption of food and manufactured goods. The merchants are assumed to receive capital bequests [8]. Production takes place in the first period and it takes one period to be completed, so during their second period individuals receive their income, optimally choose their level of consumption, and the merchants leave capital bequests. The second period consumption of an individual born at time t is $c_{t+1} = c^A_{t+1} + c^M_{t+1}$, where c^A_{t+1} and c^M_{t+1} are the individual's consumption of agricultural and manufacturing goods respectively. Note that agricultural and the manufacturing goods are assumed to be perfect substitutes in consumption, i.e., their relative price is fixed and set equal to 1. In accordance with the historical pattern, consumption of food is assumed to be constant over time and homogeneous across the population at subsistence level c^A, so that $c^A_{t+1} = c^A$ for all $t \geq 0$ and for each individual [9].

The preferences of a worker born at time t are given by

$$u_{w,t} = \ln c_{t+1}. \tag{1}$$

Preferences of a merchants born at time t are given by

$$u_{m,t} = \delta \ln c_{t+1} + (1-\delta) \ln k_{t+1}, \tag{2}$$

where $\delta \in (0,1)$, and k_{t+1} are capital bequests a merchant born at time t leaves to offspring. It is worth noting that individual capital k_t is the bequest obtained from the generation born at time (t). As production beginning at time t takes one unit of time to generate output, a merchant born at time $(t-1)$ chooses capital bequest k_t which is used in the manufacturing activity whose production begins at the same time, t. At time $(t+1)$ a merchant born at time t, and receiving capital bequests k_t, will leave capital bequests k_{t+1} used in the manufacturing activity whose production begins at time $(t+1)$, and so on.

[8] As capital owned by merchants is a perfectly divisible good, and each merchant can employ it in all the occupied lands, assumption of a constant number of merchants is not crucial for results.

[9] In describing preferences and consumption we follow Bertocchi (2006).

2.3 Production

The economy displays two specific-factor technologies producing an agricultural good by means of both land and labour, and a manufacturing good produced by means of both capital and labour. The agricultural good is produced in the countryside only. Land L is in fixed endowment and has heterogeneous fertility G_j over a continuum support $[G_{\min}, G_{\max}]$, where $G_{\max}$ is the highest fertility index and $G_{\min}$ is the lowest fertility index, with $G_{\max} > G_{\min} > 0$. Let G_{jt} indicate a land with fertility j occupied at time $t > 0$, with $G_{jt} \in [G_{\min}, G_{\max}]$. It is assumed that the more fertile lands are occupied first by populations residing in the countryside [10]. In particular, if at time $(t+1)$ a new land is occupied, it will have fertility $G_{jt+1} < G_{jt}$, and $G_{jt+1} \in [G_{\min}, G_{\max}]$ [11]. As will be clarified below, the number of lands occupied at any time $t \geq 0$ is obtained endogenously in such a way as to guarantee subsistence food for the whole population. A worker living in the countryside on land with fertility G_{jt} can employ her labour endowment E^C at any time $t \geq 0$ both in agricultural and manufacturing activities, where the labour endowment E^C is homogeneous across individuals and constant over time. We can set the labour endowment at $E^C = 1$ without any loss of generality in the analysis because there is no substantial technological progress and no educational attainments in this framework. In this way, a worker j living in the countryside can spend a share β_{jt} of her labour endowment in producing manufactured goods, and a share l_{jt} of her labour endowment in producing food, with $\beta_{jt} + l_{jt} = E^C = 1$. The choice of the share of labour endowment a worker decides to employ either in the agricultural or in the manufacturing activity is endogenous. Production of agricultural good Y^A_{jt} in land with fertility G_{jt} at time t is described by the following technology frontier:

$$Y^A_{jt} = (G_{jt}L)^{1-\gamma} (1 - \beta_{jt})^{\gamma}, \tag{3}$$

where $\gamma \in (0, 1)$, and $(1 - \beta_{jt})$ represents the share of labour endowment an individual employs in the agricultural sector on land with fertility G_{jt}. Manufacturing production in the countryside is obtained combining capital with labour according to the following technological frontier:

$$Y^{MC}_{jt} = k^{1-\gamma}_{jt} (\beta_{jt})^{\gamma}, \tag{4}$$

where Y^{MC}_{jt} is the production of manufactured goods of an individual living on land with fertility G_{jt}, and k_{jt} is the capital used by the individual at time $t \geq 0$ [12]. A worker i living in town only produces manufactured goods combin-

[10] As land is free and there entails no cost, in this stylized economy we assume that individuals will occupy the more fertile lands first.

[11] This assumption can also be read as a decreasing productivity of a given piece of land when new labour is applied on the same land. In particular, if a second individual occupies the same land of another individual, the productivity of the same land is lower for the second individual for any given effort of labour individuals spend on that land.

[12] The same qualitative results hold considering different production functions for agriculture and manufacturing in the countryside, i.e., different parameters for the Cobb-Douglas speci-

ing capital with her own labour effort according to the following technological frontier:

$$Y_{it}^{MT} = k_{it}^{1-\gamma} \left(E^T\right)^{\gamma}, \tag{5}$$

where Y_{it}^{MT} is the production of manufactured goods of individual i in town at time $t \geq 0$, and E^T is her labour endowment which is supplied inelastically. E^T is assumed to be homogeneous across individuals and constant over time, so that it can be normalized to one without any loss of generality in the analysis [13].

2.4 Labor time allocation in the countryside

Let η_{jt} indicate the share of one unit of capital employed in the manufacturing sector in the urban centre, and then $(1 - \eta_{jt})$ is the complementary share employed on a land with any fertility G_{jt}. As capital is assumed to be a perfectly divisible good, and each merchant to behave in the same way, manufacturing production in the countryside as in equation (4) can be rewritten as:

$$Y_{jt}^{MC} = \left[\left(1 - \eta_{jt}\right) K_t\right]^{1-\gamma} \left(\beta_{jt}\right)^{\gamma}, \tag{6}$$

The labour productivity in the manufacturing sector of a worker living in the countryside on land with fertility $G_{jt}L$ is:

$$\frac{\partial Y_{jt}^{MC}}{\partial \beta_{jt}} = \gamma \left[\left(1 - \eta_{jt}\right) K_t\right]^{1-\gamma} \left(\beta_{jt}\right)^{\gamma-1}, \tag{7}$$

which is decreasing in the labour effort β_{jt}. For a given labour time allocation β_{jt}, a higher capital share $(1 - \eta_{jt})$ and a higher aggregate capital K_t shift up the marginal productivity of labour in equation (7). The marginal productivity of labour in the agricultural sector in a plot of land with fertility G_{jt}, as measured by an increase in the labour time spent in the agricultural activity $(1 - \beta_{jt})$, is:

$$\frac{\partial Y_{jt}^{A}}{\partial \left(1 - \beta_{jt}\right)} = \gamma \left(G_{jt}L\right)^{1-\gamma} \left(1 - \beta_{jt}\right)^{\gamma-1}, \tag{8}$$

which is increasing in β_{jt}. For a given labour time allocation $(1 - \beta_{jt})$, a higher land fertility G_{jt} shifts up the marginal productivity of labour in equation (8), i.e., the higher the land fertility, the higher the marginal productivity of labour time in the agricultural sector. As food and manufacturing goods are assumed to be perfect substitutes in consumption, each worker j allocates her

fication of agricultural and manufacturing production. What matters for the result to hold is the essentiality of both land and labour, and of both capital and labour in agricultural and manufacturing production respectively, with appropriate parameter restrictions. The specific functional forms adopted here allow calculations to be simplified without any loss of generality in the analysis.

[13] As will be clarified later on, individual capital in town k_{it} can be expressed in terms of aggregate capital in the economy K_t.

labour time between agricultural and manufacturing activities such that a no-arbitrage condition of marginal productivities holds at each time, i.e.,[14]

$$\frac{\partial Y_{jt}^{A}}{\partial\left(1-\beta_{jt}\right)}=\frac{\partial Y_{jt}^{MC}}{\partial\beta_{jt}} \tag{9}$$

As $\frac{\partial Y_{jt}^{A}}{\partial(1-\beta_{jt})}$ is increasing in β_{jt}, while $\frac{\partial Y_{jt}^{MC}}{\partial\beta_{jt}}$ is decreasing in β_{jt}, the no-arbitrage condition (9) allows the optimal fraction of labour time β_{jt}^{*}, and therefore the labour effort both in agricultural and manufacturing sectors of any individual living in the countryside, to be determined:

$$\beta_{jt}^{*}=\frac{\left(1-\eta_{jt}\right)K_{t}}{\left(1-\eta_{jt}\right)K_{t}+G_{jt}L}. \tag{10}$$

As higher land fertility $G_{jt}L$ shifts up the labour marginal productivity curve in the agricultural sector, the no-arbitrage condition (9) implies that a higher land fertility G_{jt} generates a lower fraction of labour time spent in the manufacturing sector, i.e., the higher G_{jt} is, the lower will be β_{jt}^{*}. In this way, when a new plot of land assumed to have lower fertility than the already occupied lands is occupied, the optimal fraction of labour time β_{jt}^{*} spent on

the manufacturing activity on the marginal land is higher. Moreover, from equation (7) we derive that the higher the capital share $(1-\eta_{jt})$ employed in the countryside, the longer will be the labour time β_{jt}^{*} devoted to manufacturing activity on all the occupied lands. The same holds for a higher level of aggregate capital K_t. In the light of the above, the economy shows a structure of marginal productivities of labour in both the agricultural and manufacturing sectors. An individual living on more fertile land has higher productivity in both activities and will earn a higher income flow. In particular, a worker living in the countryside on land with fertility G_{jt} earns an income flow y_{jt}^{C} at any time $t\geq 0$ given by the sum of her agricultural production Y_{jt}^{A} and of her marginal productivity in the manufacturing production $\frac{\partial Y_{jt}^{MC}}{\partial(\beta_{jt})}$, i.e.,

$$y_{jt}^{C}=Y_{jt}^{A}+\frac{\partial Y_{jt}^{MC}}{\partial\beta_{jt}}=\frac{G_{jt}L}{\left[\left(1-\eta_{jt}\right)K_{t}+G_{jt}L\right]^{\gamma}}+\gamma\left[\left(1-\eta_{jt}\right)K_{t}+G_{jt}L\right]^{1-\gamma}, \tag{11}$$

where the optimal labour time allocation between agricultural and manufacturing activities as in equation (10) has been considered [15].

[14] See the Appendix for the explanation about both workers and merchants optimal choices. The solution is shown in the Appendix because variables not yet introduced in the main text are used in the solution.

[15] In this formulation $y_{jt}^{C}\geq c^{A}$ is assumed, so that the individual's income allows the subsistence of food to be obtained. All the qualitative mechanisms and results hold if we also take into account the case $y_{jt}^{C}<c^{A}$ for lands with low fertility which will be occupied later and later by assumption.

2.5 Guilds, merchants, and workers in urban centres

In accordance with the historical evidence we assume that merchants bear a cost to join with guilds. In particular, let F be a sunk cost flow the guilds bear to be operative and effective at each time t. We assume that the guilds' members, the merchants, pay the cost through a share $(1-\phi)$ of the final manufacturing production in town [16], i.e.,

$$(1-\gamma)(1-\phi)Y_t^{MT} = F, \tag{12}$$

where $(1-\phi)$ indicates the share of final product accruing to guilds. The aggregate manufacturing production function in the urban centres is:

$$Y_t^{MT} = (\eta_t K_t)^{1-\gamma}\left(w_t^T\right)^{\gamma}, \tag{13}$$

with $\eta_t = \int_0^{J_t}\eta_{jt}$ representing the aggregate share of each unit of capital employed in manufacturing in the urban centres, the above equation can be rewritten as:

$$(1-\gamma)(1-\phi)(\eta_t K_t)^{1-\gamma}\left(w_t^T\right)^{\gamma} = F. \tag{14}$$

From equation (14) the labour demand in the urban centre can be obtained,

$$w_t^T = \left(\frac{F}{(1-\gamma)(1-\phi)}\right)^{\frac{1}{\gamma}}(\eta_t K_t)^{\frac{\gamma-1}{\gamma}}. \tag{15}$$

Considering the number of workers employed in town as in equation (15), aggregate manufacturing production in the urban centre boils down to:

$$Y_t^{MT} = \frac{F}{(1-\gamma)(1-\phi)} \tag{16}$$

which is constant over time. From the above equation we are able to determine the share of final manufacturing production in town accruing to each merchant, i.e., $y_{m,t}^{MT} = \frac{\phi}{(1-\phi)}\frac{F}{m}$, which is constant over time and independent of both the capital and labour employed in manufacturing production. In the same way we are able to obtain the wage rate paid to any worker living in town, which is the marginal productivity of labour

$$y_{w,t}^{MT} = \gamma\left(\frac{F}{(1-\gamma)(1-\phi)}\right)^{\frac{\gamma-1}{\gamma}}(\eta_t K_t)^{\frac{1-\gamma}{\gamma}}, \tag{17}$$

[16] In a bargaining framework ϕ would be equivalent to the exponent of the guilds' payoff in the expression for the Nash product. See Mookerjee and Ray (2002). Note that the capital share of final product is $(1-\gamma)$, while the labour share would be γ if markets were perfectly competitive and factors were priced at their marginal productivity. Yet, because of the guilds' labour market power in urban centres, we could assume that capital share of the final product was $(1-\gamma)+s\gamma$, with $s \in]0,1]$ whenever a positive manufacturing production took place in the countryside, and then guilds could only appropriate a fraction of the labour share γ of the final manufacturing production. Both analysis and results hold considering such a share appropriated by merchants and guilds.

where we have omitted the subscript i for an individual because each worker will earn the same income flow in town, and where aggregate capital is considered because guilds act as economic agents in town. Let us consider the merchants' individual choice regarding capital allocation between the countryside and the urban centre. In doing so, we have to consider that each merchant takes as given the total labour time, and then the number of workers employed in the manufacturing sector both in town and in the countryside. Indeed, on the one hand the guilds exert a market power in the urban centres and decide the number of workers employed in town while, on the other hand, each merchant is unable to affect the aggregate mass of worked hours in the manufacturing sector in the countryside. From equation (15) the marginal productivity of each unit of capital in town is:

$$\frac{\partial Y_t^{MT}}{\partial \eta_{jt}} = \frac{F}{\eta_t \left(1-\phi\right)}, \tag{18}$$

which is decreasing in the aggregate capital share η_t and in capital share η_{jt} employed in town, and is independent of the level of aggregate capital K_t. The marginal productivity of the complementary share of one unit of capital employed in the manufacturing activity in the countryside on a plot of land with any fertility G_{jt} is:

$$\frac{\partial Y_{jt}^{MC}}{\partial \left(1-\eta_{jt}\right)} = \frac{\left(1-\gamma\right) K_t}{\left[\left(1-\eta_{jt}\right)+G_{jt}L\right]^{\gamma}}, \tag{19}$$

which is increasing in the capital share η_{jt}, and where the optimal labour share β_{jt}^* is considered as given by each merchant. Notice that, ceteris paribus, equation (19) shifts up with a higher level of aggregate capital and a lower level of land fertility G_{jt}. Each merchant will allocate each unit of capital in manufacturing production such that a no-arbitrage condition of marginal productivities of capital holds at each time, i.e.,

$$\frac{\partial Y_t^{MT}}{\partial \eta_{jt}} = \frac{\partial Y_{jt}^{MC}}{\partial \left(1-\eta_{jt}\right)} \tag{20}$$

As equation (18) is strictly decreasing in the capital share η_{jt} while equation (19) is strictly increasing in the capital share η_{jt}, the optimal value η_{jt}^* in any portion of land is determined, with lands with higher fertility having a higher share η_{jt}^* of capital employed in the urban centres. This implies that each merchant will employ a greater share of each unit of capital in lands with lower fertility, for any given level of aggregate capital. This means that, at any given time t, a map of capital shares $\left(1-\eta_{jt}^*\right)$ is determined, with any such share being lower in land with higher fertility $G_{jt}L$. Let us now consider capital accumulation over time. Considering condition (20) for the optimal allocation of capital between the urban centres and the countryside where land has heterogeneous fertility, as manufacturing production proceeds capital accumulation over time implies that the optimal capital share η_{jt}^* will become progressively lower over time, i.e., as capital accumulates over time each merchant has the

incentive to employ a higher share of each unit of capital in the countryside, and this holds in all the occupied lands, i.e., on land with any fertility G_{jt}. This argument can be proved using the implicit function theorem on condition (20) considering the optimal choice of η_{jt} which allows the condition to hold as identity at any time t.

2.6 Labor location choice

Let us consider the location choice of workers. To this end, we have to consider the income flow a worker can gain residing either in the urban centre or in the countryside. A worker will choose to live in the countryside on a piece of land with any fertility G_{jt} whenever her income flow there is higher than that gained in town $y_{jt}^{C} \geq y_{w,t}^{MT}$, i.e., whenever

$$\frac{(1+\gamma)\, G_{jt} L + \gamma \left(1-\eta_{jt}^{*}\right) K_t}{\left[\left(1-\eta_{jt}^{*}\right) K_t + G_{jt} L\right]^{\gamma}} \geq \gamma \left(\frac{F}{(1-\gamma)\,(1-\phi)}\right)^{\frac{\gamma-1}{\gamma}} \left(\eta_t^{*} K_t\right)^{\frac{1-\gamma}{\gamma}}. \qquad (21)$$

Let us consider condition (21) at the onset of the period under consideration, i.e., at time zero. As the income flow earned in the countryside is an increasing function of land fertility G_j , we assume that population size is great enough for a threshold level of land fertility $G_{j0}^{*} < G_{\max}$, and therefore of the number of occupied plots of land at time zero, J_0^{*}, exists whereby a positive value for the number of workers living both in town and in the countryside is obtained at time zero. In particular, at the onset of the period under scrutiny, individuals living on land with fertility $G_{j0} \in \left[G_{\max}, G_{j0}^{*}\right]$ will find it profitable to live in the countryside, while the rest of the workers will live in town. Note that, in condition (21) K_t and η_{jt}^{*} change over time as well as the number of occupied plots of land J_t. As manufacturing production proceeds and capital accumulates over time, each merchant will find it optimal to employ a smaller share of capital town, i.e., $\eta_{jt+1}^{*} < \eta_{jt}^{*}$ for $K_{t+1} > K_t$ for all $j \in [0, J_t]$ (see condition 20). At this stage of the analysis, three dynamic paths for the income flow of workers, and then for the number of workers living either in town or in the countryside, are at least in principle possible. The former consists in an increase in the income flow in town larger than the increase in the income flow in the countryside, i.e., $\frac{y_{w,t+1}^{MT}}{y_{w,t}^{MT}} > \frac{y_{j,t+1}^{C}}{y_{j,t}^{C}}$, for all G_j, and for all time $t > 0$. This scenario occurs when the increase in capital accumulation outweighs the decrease in the aggregate share η_t^{*}, so that the aggregate capital share in town $\eta_t^{*} K_t$ becomes progressively higher over time. In this case, the guilds will employ a progressively lower number of workers in town (see condition 17), and the merchants will find it profitable to employ their own capital in the countryside to save on costs, with the consequence that a larger number of workers will move there. The second possible dynamic path consists in an increase in the income flow which is smaller in town than in the countryside, i.e., $\frac{y_{w,t+1}^{MT}}{y_{w,t}^{MT}} < \frac{y_{j,t+1}^{C}}{y_{j,t}^{C}}$, for all G_j, and for all time $t > 0$. Even in this case the increase in capital

accumulation outweighs the decrease in the aggregate share η_t^*, so that the aggregate capital share in town $\eta_t^* K_t$becomes progressively higher over time. In this case workers would find it profitable to move to the countryside, so the number of workers in town should decrease over time as predicted by condition (17). Note that also in this case the merchants save on costs by investing their capital in the countryside rather than in town whenever the following condition is satisfied: $y_{w,t}^{MT} \geq \int_{G_{\max}}^{G_{jt}} y_{w,t}^{C}$, i.e., $K_t \leq \bar{K} \equiv \frac{F\left[\frac{(1-\phi)(1-\gamma)m+\gamma}{(1-\phi)(1-\gamma)}\right]-(1+\gamma)(G_{\max}L)^{1-\gamma}}{\gamma(G_{\min}L)^{-\gamma}}$. The last possible dynamic path consists in a decrease in the income flow in town, while the income flow in the countryside grows progressively higher, i.e., $y_{w,t+1}^{MT} < y_{w,t}^{MT}$, and $y_{j,t+1}^{C} > y_{j,t}^{C}$, for all G_j, and for all time $t > 0$. This scenario occurs when the decrease in the aggregate share η_t^* outweighs the increase in capital accumulation, so that the aggregate capital share in town $\eta_t^* K_t$ steadily declines over time. This dynamic path is excluded by the model's prediction. A simple logical argument proves this by contradiction. Let us suppose that it is, rather, the case. As aggregate capital accumulates over time due to manufacturing production taking place both in town and in the countryside, the aggregate share of capital employed in town dwindles over time, i.e., $\eta_t^* K_t$ steadily declines. Then, the income flow achieved in town, $y_{w,t}^{MT}$, will sink ever lower over time, while the income flow obtained in the countryside will grow progressively higher on the land already occupied, i.e., given the land fertility. If the workers move to town, as supposed above, the dynamics of the income flow in town are reinforced because a lower number of lots of land will be occupied over time, i.e., J_t will become progressively lower. However, the income flow in town decreases monotonically while the income flow in the countryside on any occupied land will increase monotonically over time because of capital accumulation K, a higher capital share η_j^*, and higher fertility G_j because the workers will leave the less fertile land first in the course of time due to the lower income flow earned there. In this way, workers will have the incentive to move to the countryside, which contradicts the initial assumption of an increasing number of workers moving to town. Note that, as the income flow paid in town decreases over time, the guilds will find it profitable to occupy a higher number of workers in town, but no individual merchant will. Thus, even if the dynamic path of the optimal capital share employed in town is decreasing over time, this cannot determine an income flow paid in town lower than the income flow paid in the countryside over time. This dynamic path is therefore excluded from the model's prediction, and it is also implausible in the light of the historical evidence. The first two dynamic paths predicted by the model are compatible with the historical evidence concerning the protoindustrialization process as described in the former sections of the paper. Indeed, if the increase in the income flow in town outweighs the increase in the income flow in the countryside over time, the merchants will find it profitable to employ an increasing share of capital in the countryside because of the saving on labour cost in the countryside, and the workers will be induced to live there because the guilds impose a steadily decreasing number of workers in town. Note that the output share accruing to a merchant from manufacturing production in the countryside on

land with any fertility is $y_{m,t}^{MC} = \frac{1-\gamma}{m} \frac{\left(1-\eta_{jt}^{*}\right)K_t}{\left[\left(1-\eta_{jt}^{*}\right)K_t+G_{jt}L\right]^{\gamma}}$ which increases as capital accumulation proceeds over time because both K_t and $\left(1-\eta_{jt}^{*}\right)$ grow steadily over time, while the output share accruing to a merchant from manufacturing production in town is $y_{m,t}^{MT} = \frac{\phi}{(1-\phi)}\frac{F}{m}$, which is constant over time and independent of capital. In this way, as capital accumulates each merchant has the incentive to move manufacturing production to the countryside.

2.6.1 Rents from capital

Let us turn now to the merchants choice of capital usage of the. In accordance with the historical evidence, each merchant can employ her capital bequests in alternative uses receiving a flow return r per unit of capital and time. A merchant will employ capital in manufacturing activity whenever the rent flow from manufacturing outweighs the rent flow from alternative uses of capital, i.e.,

$$\frac{F\phi}{m\left(1-\phi\right)} + \frac{\left(1-\gamma\right)}{m}\int_0^{J_t} \frac{\left(1-\eta_{jt}^{*}\right)K_t}{\left[\left(1-\eta_{jt}^{*}\right)K_t+G_{jt}L\right]^{\gamma}} \geq rk_t, \tag{22}$$

Both terms on the left hand side of inequality (22) are strictly positive, and the second term reach the highest lower bound at zero. In this way, a sufficient condition for inequality (22) to hold is the following:

$$\tilde{k} \equiv \frac{F\phi}{rm\left(1-\phi\right)} \geq k_t \tag{23}$$

For $k_t \leq \tilde{k}$ a merchant will find it profitable to invest her capital in manufacturing production. It is worth noting that condition (22) can be applied for comparison across the European countries in order to understand why Great Britain employed capital in manufacturing and not in the alternative uses. At the beginning of our story (15th century) the leading areas of Europe enjoyed greater rent per unit of capital in non-manufacturing uses than Great Britain. The historical evidence shows that the rent of capital employed in long-distance trade was higher for both the Italian cities and the Low countries because they were situated at the heart of the trade routes until the end of the 15th century. Moreover, financial assets were more profitable in those areas than in Great Britain thanks to the more efficient and developed financial sectors [17].

[17] The rise of a modern financial system dates back to the late 17th century in England according to Rousseau and Sylla (2005). As a matter of fact, overall non-manufacturing rent of capital can be assumed to be higher in the leading European areas than in Great Britain in the early XV century. Thus, capital flowed into the manufacturing sector as long as the rent of alternative uses was lower. Because the differences in the rent of capital employed in manufacturing industry were likely to be lower across the leading European areas our equation can safely be seen as a condition to understand why Great Britain started original capital accumulation in manufacturing production before the others.

2.7 Utility maximization

Utility maximization subject to budget constraint generates the worker's i demand function $c_{wt+1} = y_{wt}$. Moreover, utility maximization subject to budget constraint generates the merchant's demand function $c_{mt+1} = \delta y_{mt}$, and capital bequests $k_{t+1} = (1-\delta)\, y_{mt}$. Aggregating this last condition across merchants allows the law of motion of the aggregate capital to be obtained:

$$K_{t+1} = (1-\delta)\,(1-\gamma)\, Y_t^M. \tag{24}$$

3 Market clearing and equilibrium

The labour market clearing condition is:

$$N_t = w_t^C + w_t^T + m. \tag{25}$$

The agricultural and the manufacturing markets must also be cleared at each t, implying:

$$Y_t^A = \int_0^{J_t} Y_{jt}^A = c^A \left(w_t^C + w_t^T + m\right) = c^A N_t, \tag{26}$$

where we have put consumption of agricultural goods at the subsistence level c^A for all the population at any time $t \geq 0$. Equation (26) makes it possible for the number of plots of land J_t which allow for a guaranteed subsistence level of food to each individual actually to be obtained at each $t \geq 0$. Total production in the manufacturing sector allows the following market clearing condition to be obtained

$$Y_t^M = c_{t+1}^{MC} w_t^C + c_{t+1}^{MT} w_t^T + c_{t+1}^{Mm} m, \tag{27}$$

where consumption of manufactured goods differs across the population. In this way, it is the consumption of manufactured goods that generates inequality across the population in the economy. At this stage, we can define what a perfect foresight equilibrium in this economy is:

Definition 1 *A perfect foresight equilibrium is a sequence*

$$\left\{c_t^{MC}, c_t^{MT}, c_t^{Mm}, w_t^C, w_t^T, Y_t^A, Y_t^M, \left\{\beta_{jt}^*\right\}_{j=0}^{J_t}, J_t, k_t, \left\{\eta_{jt}^*\right\}_{j=0}^{J_t}\right\}_{t=0}^{\infty}$$

such that at each t utility and profits are maximized, all markets clear.

Equation (9) allows us to determine the entire structure of $\left\{\beta_{jt}^*\right\}_j$, and the labour time allocation between agricultural and manufacturing activities in the countryside with heterogeneous land fertility. With the equations of the individual income flows of the workers (in town and in the countryside) and the merchants, equations (20) and (14), and equations (24)-(27), jointly with the

subsistence level c^A, it is possible to determine the consumption of manufactured goods of each individual $c_t^{MC}, c_t^{MT}, c_t^{Mm}$, the manufacturing production Y_t^M, the individual capital k_t, the number of workers in town w_t^T and in the countryside w_t^C, and the optimal capital share η_t.

4 Model's predictions and historical data

This section shows how the model is able to capture the historical evidence. The key elements we analyse are the following: 1) the path of capital accumulation; 2) the path of value added in the manufacturing industry; 3) the allocation of capital in the manufacturing industry between countryside and town.

4.1 Capital accumulation and production in the manufacturing industry

Firstly, we determine the overall manufacturing production by aggregating the production occurring in each land (6) and the aggregate manufacturing production in town (see section 2.5). At this point, we obtain the following equation for the overall manufacturing production:

$$\begin{aligned} Y_t^M &= \left\{ \left[\int_0^{J_t} \left[(1-\eta_{jt}) K_t \right]^{1-\gamma} \left(w_t^C \beta_{jt} \right)^{\gamma} dj \right]^{\sigma} + \left[\left(\eta_t K_t \right)^{1-\gamma} \left(w_t^T \right)^{\gamma} \right]^{\sigma} \right\}^{\frac{\gamma}{\sigma}} = \\ &= K_t^{1-\gamma} \left\{ \left[\int_0^{J_t} \left(1-\eta_{jt} \right)^{1-\gamma} \left(w_t^C \beta_{jt} \right)^{\gamma} dj \right]^{\sigma} + \left[\eta_t^{1-\gamma} \left(w_t^T \right)^{\gamma} \right]^{\sigma} \right\}^{\frac{\gamma}{\sigma}} \end{aligned} \tag{28}$$

The overall manufacturing production function (28) preserves the technological possibilities set in the manufacturing sector at the individual level (see equations (4) and (13)). At the same time, it allows for any configuration embracing technological combination and substitutability of labour efforts in town and in the countryside, as represented by any value of the elasticity of substitution $\sigma \in (-\infty, 1]$. In estimating equation (28) we come up against several data constraints on the productivity of free lands G_j, on the optimal share of capital η_{jt}, on the optimal labour time share β_{jt}, and on the breakdown of workers between town and countryside which are not available in the historical data. As the estimation is prevented by lack of data, an approximation of equation (4) is the only way to estimate the total stock of capital for the British manufacturing sector. We assume that the term in brackets reduces the overall number of workers employed in the manufacturing industry (data are provided by Broadberry et al. (2011). As this term has to be expressed in value to be rendered homogeneous with capital and production, we can alternatively use data for the income flow and for the subsistence of individuals. With the two measures it is possible to highlight the role of (no) technological progress in both the capital accumulation and the manufacturing production. In the former case, use of the annual wages allows for possible technological improvements in the form of labour augmenting technological progress to be captured.

On the contrary, when a measure of constant subsistence is used, no labour augmenting technological progress can occur. Since we assume no technological progress in the early modern period the two estimations should overlap, as will be demonstrated later on.

Figure 1 plots the path of capital accumulation from 1300 to 1750 for different values of the capital share where workers are evaluated at their wage by multiplying the number of workers by the daily real wages series provided by Clark (2005) times the number of worked days drawn by Broadberry et al. (2011).

Figure 1 about here

It is worth noting that our results are not affected by the value of capital share (γ). Moreover, we observe two key turning points. The first is around the middle of the 16th century when the Guilds began to lose their power in England, and the second around the middle of the 17th century when proto-industry arose. We use the same set of assumptions and the resulting estimates of total capital in manufacturing industry to derive an estimation of the manufacturing production. In Figure 2 we plot our estimation over time compared to the manufacturing production reconstructed by Broadberry et al. (2011) until 1750 with $\gamma = 0.5$. Again, our results are not affected by the capital share value [18] .

Figure 2 about here

The manufacturing production generated by our model is able to capture the pattern portrayed in the historical data. An interesting point is raised by the next Figure, where we compare the actual production and two alternative estimated productions over a longer time span.

Figure 3 about here

As the figure shows, the pattern of manufacturing production is different from the middle of the 18th century onwards. When workers are evaluated at subsistence level we capture the pattern of the manufacturing production which would be driven by pure physical capital accumulation with no role for technological progress. On the contrary, the evaluation of workers at their average annual wages allows for labour augmenting technological change to be (eventually) embodied in the manufacturing production pattern. The two estimations overlap in the early modern period until the end of the 17th century, confirming that manufacturing production increased because of pure physical capital accumulation. Since then, the patterns diverged because of the labour augmenting technological progress as captured by the annual real wages.

4.2 Capital allocation

Although no breakdown of capital between countryside and town is available in the historical data, we can derive an expression for η_t by equalizing equations (18) and (19). As can readily be seen, a closed form for this expression can be

[18] The estimations of the manufacturing production for different values of γ are available upon request.

obtained for $\gamma = 0.5$. Because both the rent of land and the arable land enter the computation of marginal productivity of capital in the countryside, their estimates are crucial in the calculation of the breakdown of capital between town and countryside. The rents we refer to are those earned outside the large farmland, which in turn are the main source for the current available time series of land rental. It goes without saying that rent earned on the large farmland is likely to be higher than our ideal rent. Thus, in using the land rental provided by Clark (2002) we are likely to overestimate the value of η_t somewhat so that our estimates of capital share in the countryside does not suffer from overestimation (see equations 18 and 19). For this reason we present a plot of $(1 - \eta_t)$ in Figure 4 which is to be interpreted as its path over time rather than a precise breakdown of the capital employed in manufacturing in the countryside.

Figure 4 about here

As Figure 4 shows, in the 17th century the system of proto-industry was on the way to assuming a central role in capital accumulation until the Classical industrial revolution came under way.

5 Conclusions

The historical evidence suggests that England, the first country on the road to industrialization, experienced a moderate growth in manufacturing production in the three centuries before the start of the classical industrial revolution. We argue that an early phase of capital accumulation created the premises for the modern sustained growth path. Our capital accumulation model considers the behaviour of a class of capitalists, the merchants, who moved production from the urban centres to the countryside in order to escape from the control of the guilds and save on production costs. This industrial organization, known as proto-industry or the putting-out-system, allowed for capital accumulation in the countryside whereby manufacturing production increased as long as the cost of labour was relatively cheap. The dynamics of capital is driven by the increase in the workforce employed in manufacturing and by the share of time spent in the production of industrial goods. Thus our model, built upon the historical evidence of the early modern period, replicates the historical data reconstructed by recent studies and challenges the idea of a stagnant phase before the classical industrial revolution. Moreover, whenever the very long run model predictions are compared to the historical records we can assess that the long pattern of growth of the manufacturing production would have been less prosperous than it actually was if the technological revolution had not in fact occurred around the middle of the 18th century.

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APPENDIX In this Appendix the utility maximization problem of individuals is analysed. Let us consider the workers first. A worker born at time t chooses her consumption solving the following problem:

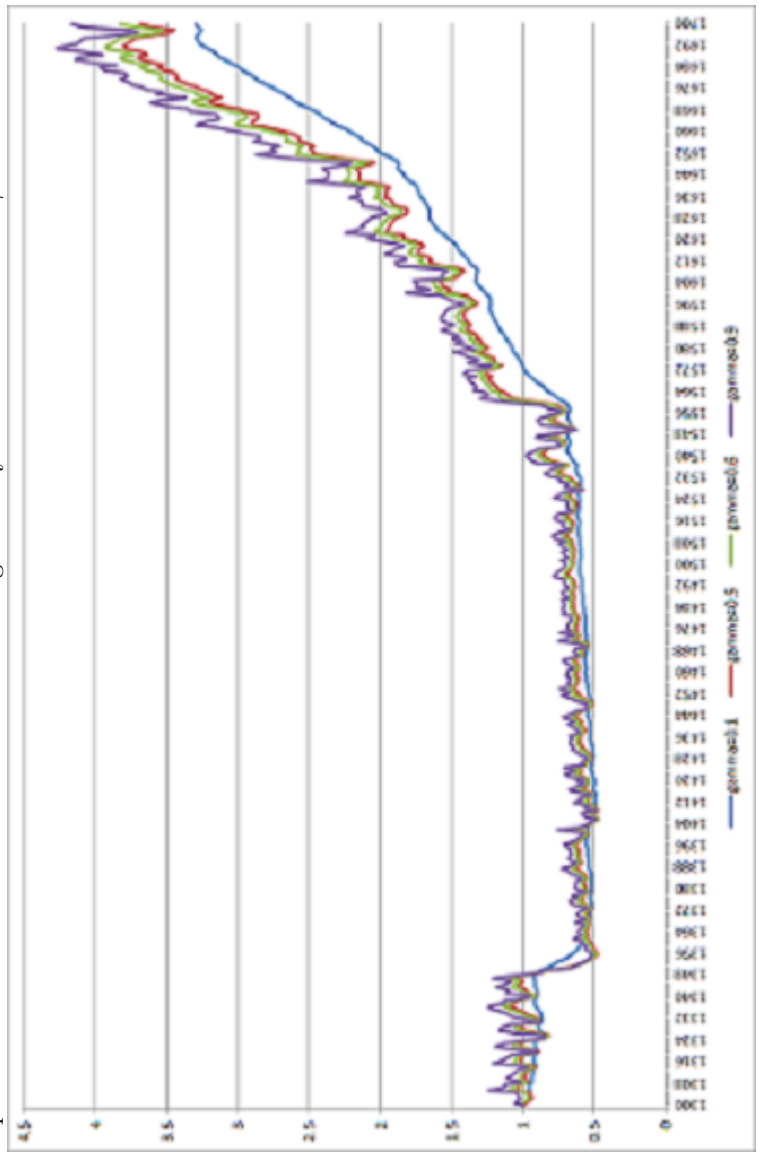
$$\begin{array}{c} \underset{c_{t+1}}{Max} \ln c_{t+1} \\ s.t. c^A + c^M_{j,t+1} \leq y^C_{jt} = Y^A_{jt} + \frac{\partial Y^{MC}_{jt}}{\partial \beta_{jt}} \end{array} \tag{A1}$$

As the consumption of food c^A is assumed to be strictly positive and exogenously given at the subsistence level for any individual at any time $t \geq 0$, and the standard Inada condition on the marginal productivity of labour time in the manufacturing activity in the countryside holds for $\beta_{jt} \to 0$, it follows that the budget constraint in problem (A1) holds with equality and the individual maximizes her utility choosing the optimal allocation of her labour time between agricultural and manufacturing activities by equalizing the respective marginal productivities, as shown in the main text in condition (9). Let us turn now to the utility maximization problem of a merchant born at time $t \geq 0$. A merchant chooses both her consumption and capital bequest solving the following problem:

$$\begin{array}{c} \underset{\{c_{t+1}, k_{t+1}\}}{Max} \ \delta \ln c_{t+1} + (1-\delta) k_{t+1} \\ s.t. c^A + c^M_{t+1} \leq \frac{1-\gamma}{m} \left(\phi Y^{MT}_t + Y^{MC}_t \right) \\ k_{t+1} = \frac{1-\gamma}{m} \phi Y^{MT}_t + Y^{MC}_t \end{array} \tag{A2}$$

where the right hand side of the budget constraint is obtained considering that $\beta_{jt} \frac{\partial Y^{MC}_{jt}}{\partial \beta_{jt}} = \gamma \left[(1-\eta_{jt}) K_t \right]^{1-\gamma} (\beta_{jt})^{\gamma} = \gamma Y^{MC}_{jt}$. As the consumption of food c^A is assumed to be strictly positive and exogenously given at the subsistence level for any individual at any time $t \geq 0$, the number of workers both in town w^T_t and in the countryside w^C_t, the number of merchants m, the share of labour time β_{jt}, and the capital k_t are all taken as given, a merchant maximize her utility choosing the optimal share of each unit of capital η_{jt} employed in town, and then the optimal share of capital $(1-\eta_{jt})$ employed in the countryside, by equalizing the respective marginal productivities, as shown in condition (20) in the main text. Note that the maximization problem in (A2) holds when each merchant employs her own capital on all the occupied lands. Yet, the same results hold considering that each merchant employs capital on a given plot of land occupied by a worker, given that provided that the number of merchants is high enough and that they act competitively in allocating capital in the countryside. Q.E.D.

Figure 1: Capital accumulation in the British Manufacturing Industry for various values of γ. Index numbers (1300=1)



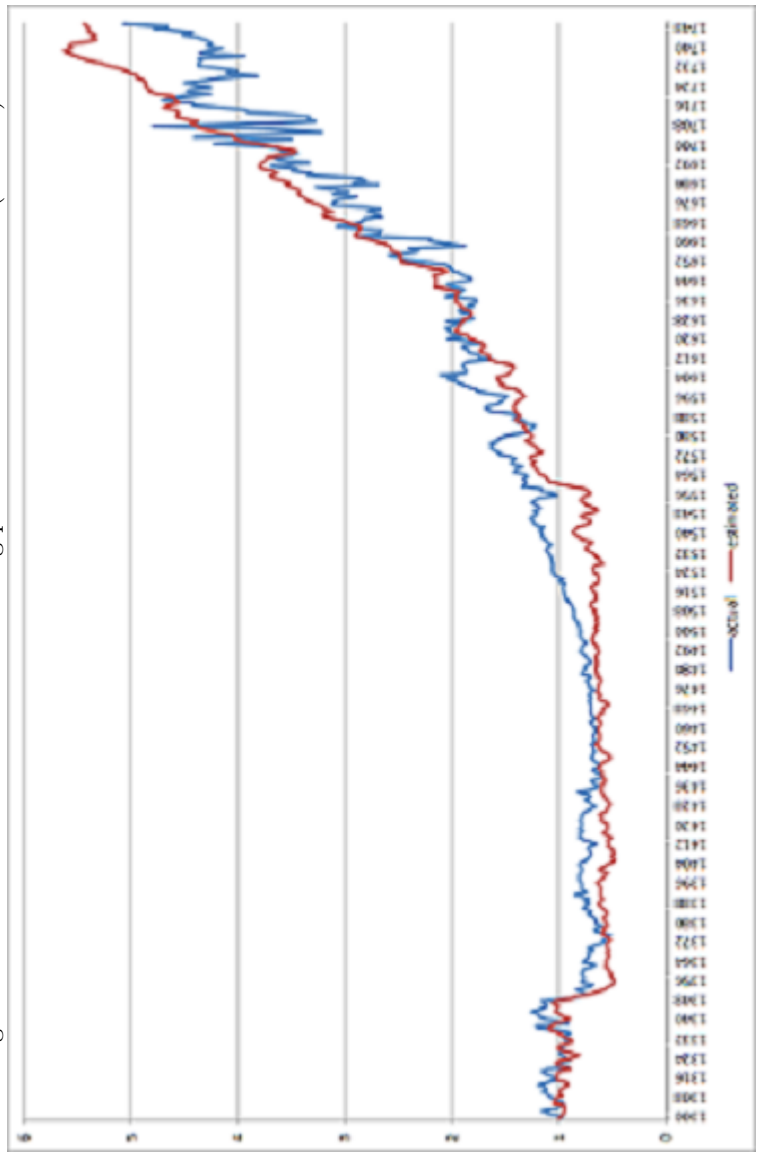


Figure 2: Estimated vs actual manufacturing production. Index numbers (1300=1)

Figure 3: Estimated vs actual manufacturing production in the very long run. Index numbers (1300=1)

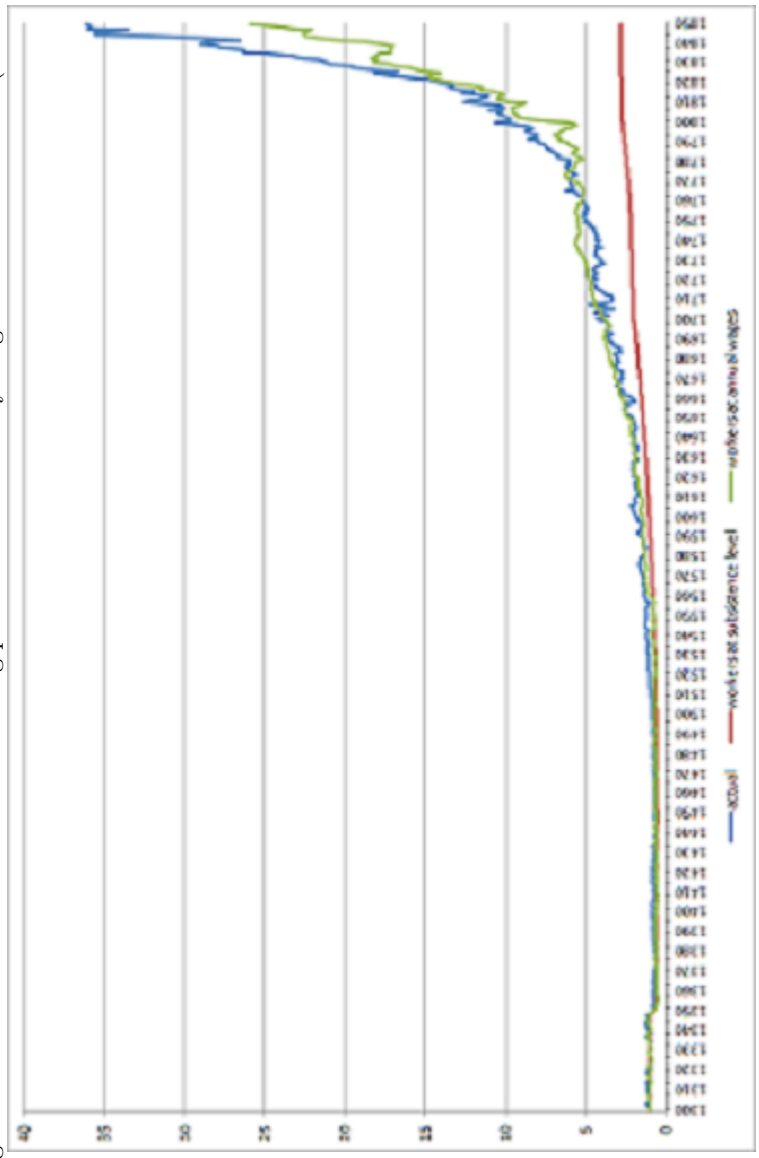


Figure 4: Pattern of the share of capital accumulated in the manufacturing industry of the countryside. Index numbers (1500=1)