

DISCUSSION PAPER SERIES

No. 9363

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ECONOMIC HISTORY



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Discussion Paper No. 9363
February 2013

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February 2013

ABSTRACT

Did Muhammad Ali Foster Industrialization in Early 19th Century Egypt?*

Muhammad Ali, who ruled Egypt between 1805 and 1849, intervened in Egyptian markets in an attempt to foster industrialization, especially between 1812 and 1840. Like a modern marketing board, the state purchased agricultural commodities (cotton, wheat) at low prices and sold them on world markets at much higher prices, a policy equivalent to an export tax. Ali also replaced tax farming with his own land taxes. The revenues so derived were used in part to finance manufacturing investment and to build irrigation canals. In addition, Ali supplied flax and cotton at those cheap purchase prices to domestic textile manufacturing, thus subsidizing the industry. He also used non-tariff barriers to exclude foreign competition from domestic markets. Were Ali's state-led policies successful in fostering industry? The answer is no easier to extract from this phase of Egyptian history than from other poor countries at that time since Egypt faced the same terms of trade boom typical of most poor commodity exporters – Egyptian export commodity prices soared relative to manufactured imports, forces that were causing de-industrialization everywhere else in the poor periphery. Ali picked a very difficult time to pursue his agenda, but we show that his policies were successful.

JEL Classification: F1, N7 and O2

Keywords: 19th century, de-industrialization, Egypt, industrial policy and trade

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*Paper to be presented to the First CEPR Economic History Symposium, Perugia, 12-14 April 2013. We gratefully acknowledge the help of Patrick O'Brien, Roger Owen, Şevket Pamuk, Mohamed Saleh and Tarek Yousef with the data and the literature.

Submitted 18 February 2013

Introduction and Motivation

The long 19th century saw a series of important transformations in international production and trade. Together with greater global commodity market integration, these forces had a profound impact on small-scale, labor-intensive industries worldwide. Since the last decades of the 18th century, European factories had penetrated Egypt's markets, exporting cheap industrial commodities which competed with local goods, mirroring a broader trend globally.¹ Manufacturing output based on pre-industrial technology declined everywhere in the so-called periphery, displaced by imports of European factory-made commodities: thus, de-industrialisation became the norm everywhere in the poor periphery.²

We know that a booming terms of trade contributed to Egyptian de-industrialization in the second half of the 19th century through so-called 'Dutch disease' effects (Williamson 2011: Chp. 7; Pamuk and Williamson 2011; Panza, 2012b). That is, as prices of commodity exports rose, labor and other resources were transferred from other agricultural activities and industry to the export sector so as to augment its capacity. The story was quite different for Egypt in the first half of the 19th century, when Muhammad Ali, who ruled between 1805 and 1849, embarked on an ambitious program to modernize and industrialize his country.³ There was also an Egyptian commodity export boom during Ali's time, when Egyptian commodity export prices rose steeply and manufactured goods prices fell sharply in world markets, the latter the result of increasingly productive British factories flooding world markets with cheaper goods. However, the

¹ Raymond (1973-4) suggests that the effects of European competition started being felt seriously at the end of the 18th century, when the influx of imported textiles depressed the price of local textiles and may have ruined many local artisans.

² For modern studies, see Clingingsmith and Williamson (2008) on India, Dobado, Gomez, and Williamson (2008) on Mexico, Pamuk and Williamson (2011) on Ottoman Turkey, and Panza (2012a; 2012b) on the Middle East.

³ Muhammad Ali, born in the Macedonian village of Kavala, was sent to Egypt as a Sultan's officer to fight against Napoleon. After leading a popular revolt in Cairo, he was appointed as the Pasha of Egypt (Batou 1991:182).

implications were different: Ali intervened to keep foreign manufactures out of Egyptian markets either by non-tariff barriers or by subsidy.

The success of Ali's state-led industrialization policies is widely debated in the literature: while some are skeptical about whether his policies resulted in industrialization,⁴ others highlight the importance of his achievements.⁵ This paper aims to evaluate the impact of Ali's policies and of world market forces during those four decades of state-led development. Part of our goal is to assess the impact these had in augmenting Egyptian competitiveness with foreign manufactures. We do not attempt to judge the efficiency of his policies, nor to ask whether other measures might have yielded better results, nor to estimate the cost of his industrialization policies on his subjects. Ours is a more limited goal: we only wish to assess the direction and magnitude of the policy impact.

During the century before about 1860, when foodstuffs for village peasants and the urban working class (like maize and fava beans) were rarely traded internationally and when foodstuffs were a very large share of family budgets, labor productivity in food production is likely to have influenced manufacturing wages and thus competitiveness, as Alexander Gerschenkron (1965) and W. Arthur Lewis (1978) argued long ago. After all, in a pre-industrial economy with relatively stable subsistence wages (Lewis 1954), any decline in Egyptian food productivity would have put upward pressure on food prices and thus on the nominal wage in every non-food sector, eroding Egyptian competitiveness with foreign producers. This would have been

⁴ Owen had some doubts on the nature of Egypt's industrialization, as he highlights: 'Indeed, even to characterize Muhammad Ali's program of factory construction as industrialization is to beg all kinds of questions, given the very limited use of power driven machines' (Owen, 1981:72). Bowring, too, criticizes Ali's industrialization policies (1840: 29).

⁵ Batou (1991: 181) was supportive of Ali's policies: "In the first half of the 19th century Egypt experienced rapid growth of modern industry: its achievements were not so different from those of certain Western European regions. As regards industrial cotton spinning, Egypt was probably fifth in the world (for the number of spindles per capita), after Great Britain, Switzerland, the US and France."

manifested by rising food prices relative to other products, by falling profitability in manufacturing, and by a decline in industrial output. This economic argument was invoked by Lewis (1978) some time ago to help explain de-industrialization in the tropical periphery. But Lewis did not offer an explicit model or supply comprehensive empirical support for his thesis. When explicit and testable Lewis-like models were constructed more recently, it turns out that his thesis works well in accounting for the spectacular demise of Indian manufacturing in the face of British competition after 1750 (Clingingsmith and Williamson 2005). It also works well in accounting for Ottoman Turkish (Pamuk and Williamson 2011), Mexican (Dobado, Gomez and Williamson 2006), and Southeast Asian (Williamson 2011: Chps. 4 and 5) de-industrialization experience. However, it might have worked less well in Ali's Egypt if he successfully controlled nominal wages in industry.

The early 19th century Egyptian case was, however, far more complex than that of India, Mexico, the Ottomans, and elsewhere in the poor periphery since Muhammad Ali intervened in Egyptian markets in an attempt to improve the competitive position of domestic industry and to foster industrialization, especially between 1812 and 1840. He also intervened in an effort to augment state revenues to finance his expansive military agenda. Thus, Ali adopted a series of state-led fiscal and trade policies aimed at moving resources in to industry and increasing government revenues. One of the most important reforms was the replacement of tax farming with a system where land revenues accrued directly to the state. The reform also extended taxable land through the introduction of a tax on *waqfs*, landholdings managed by religious

authorities and devoted to charitable purposes.⁶ *Waqfs* constituted around one fifth of the total cultivable land (around 600,000 feddans in 1812)⁷.

Ali also used protectionist measures to shelter his industries. While tariff heights were constrained by the 1838 Anglo-Ottoman treaty, keeping Egyptian tariffs on British cloth at a very low revenue-producing 3 per cent, Ali used what economists now call non-tariff barriers to pretty much exclude foreign manufactured imports whenever local industry needed protection: military clothing could only be supplied by his factories; he had the power to force his subjects to buy the products of Egyptian factories before buying a foreign substitute; and he could impose internal tariffs on imported goods which were sold in the interior (Owen 1981: 46; Batou 1991: 200-201). Indeed, Rivlin (1961: 191) and Marsot (1984: 195) note that Ali used many devices to prevent transactions between merchants and customers involving imported goods. To help implement this policy, domestic textiles were given a special stamp and orders were given that anyone found without the stamp be punished.

But these were certainly not all the tools Ali brought to bear: another cornerstone of Ali's policies was the establishment of state-sanctioned monopolies, whereby the government was the only intermediary between farmers and merchants. This system of monopolies started with the wheat and rice markets in 1812 and was quickly extended to all commercial crops. By creating something like a modern marketing board, the state purchased agricultural export products (cotton, flax, rice, wheat, sugar) at low prices and then sold them on world markets at far higher prices, a policy equivalent to an export tax. As we shall see below, this virtual export tax was

⁶ Tax farming was abolished in 1807 in Upper Egypt and by 1814 in Lower Egypt.

⁷ The land tax on *waqfs* was lower than on other landholdings (Issawi 1966).

much bigger than the modest Ottoman legislated export tax limit of 12 per cent mandated in the 1838 Anglo-Turkish Convention.

The policy of Soviet Russia in the 1930s and Third World in the post-WW2 era was for the state to force the sale of village foodstuffs at low prices, keeping urban living costs low, thus keeping industrial wages low and making industry more competitive. Ali did quite the opposite. His state 'marketing board' certainly bought food from farmers at low prices but – in contrast – then sold these foodstuffs in urban markets at higher prices, raising the cost of living and perhaps therefore nominal wages in manufacturing, higher than they would have been otherwise. His motivation was clear: in contrast with Soviet Russia and the Third World, his policy raised revenues. True, his food price "squeeze" policy would have put upward pressure on the urban nominal wage were labor markets free to adjust. But they were not free to do so under Ali's regime. Thus, we shall see that nominal wages never rose and real wages in cities and towns declined. This plus the fall in farm incomes lowered real incomes for all workers, urban and rural. After all, someone had to pay for Ali's forced industrialization and expansionist military policies!

The monopoly system also regulated urban textiles production: craftsmen were forced to work in state factories and all existing private urban workshops were shut down. Ali extended control over village production too, instructing his officials to buy all the cloth and yarn manufactured by peasants (and at his lower prices: Owen 1981).

Perhaps most important, the 'marketing board' supplied the domestic textile industry with cotton, flax, and other intermediates at their cheaper purchase prices, a policy that subsidized local textile and other manufacturing sectors. The low purchase prices for cotton, flax, wheat and non-tradable foods must have reduced farmers' supply-side incentives and thus Egyptian farm

output, but Ali also invested some of the ‘marketing board’ and land tax revenue in irrigation and transportation infrastructure, investments which should have partially or perhaps even completely offset farmers’ supply disincentive of the artificially low farm prices.

Starting in 1840 and certainly by 1849, the ‘virtual’ export tax and the food price ‘squeeze’ had diminished as Ali’s hard line policies softened in the face of hunger and political discontent on the one hand, and of the stipulation of the 1838 Anglo-Turkish Convention on the other.⁸ After Ali’s death, the ‘state-led’ policies disappeared entirely, replaced by a more pro-global and pro-market *laissez faire* regime, later reinforced by British colonization in 1882.

Thus, there were two distinct economic regimes in 19th century Egypt, one before and one after about mid-century, the first anti-global and anti-market and the second pro-global and pro-market. Ali performed a social experiment for historians to assess: Did his policies foster industrialization, or at least greatly suppress de-industrialization? To complicate any assessment of Egyptian industrial performance between these two regimes, however, recall that Egyptian export prices boomed (and manufactures prices collapsed) before and after Ali’s time – thus fostering deindustrialization in both episodes. But it appears that the Egyptian terms of trade (P_x/P_m) rose by much more during Ali’s rule than after, and compared with the rest of the poor periphery. Thus, Ali introduced his state-led policies during terms of trade boom, a commodity export expansion, and when world deindustrialization forces were most powerful. In short, Ali picked a most challenging time to implement his state-led industrialization policies.

⁸ The Anglo-Turkish Convention was signed between England and Egypt’s suzerain ruler, the Ottoman Empire. It prohibited all monopolies, allowed British merchants to buy goods anywhere in the Empire without the payment of any taxes and imposed a 3 per duty on imports, 12 percent on exports, 3 percent on transit (Issawi 1982: 19). It is often considered by the literature as an attempt to break Muhammad Ali’s hold on agricultural distribution (Ishida 1972: 178; Rivlin 1861; Batou 1991: 207; Issawi 1982: 20), perhaps an indication of the effectiveness of his policies.

A final introductory remark is needed. English visitors had a poor opinion of Ali's factories: "An Englishman ... visited Egypt in the early 1830s leaving a graphic description of the mills. According to his estimates, 50 per cent of the raw material was wasted as a result of carelessness. [His] evaluation of the finished product was equally gloomy (Owen 1981: 70)." Maybe so, but visitors to poor countries with emerging industries have always voiced such opinions, including British visitors to America in the 1830s, and American visitors to the Philippines in the 1930s. The use of labor-intensive and small scale operations -- without steam or water power (Owen 1981: 72) -- makes sense where labor is cheap and where energy and machines are expensive (Allen 2009). And where cotton is abundant, why not use techniques that 'waste' it? And where capital-intensive and sophisticated technologies are needed for high-count luxury cloth, it made sense for the Egyptians to import such goods, especially since most locals could only afford cheap cloth. In any case, by 1834 Egypt was tied with Spain for the fifth highest spindle/population ratio in the world (Batou 1991: 183-4), and local factories were able to drive imports of lower quality textiles out of Egyptian markets (Rivlin 1961: 197). Furthermore, "Egyptian factories were provided with jennies and looms made by Egyptian carpenters, smiths and turners under the direction of French technicians (Owen 1969: 44)."

We appreciate that Ali often supplied his 'state industries' with incompetent (military) managers, with equipment that was poorly maintained, and so on, but our focus is on the impact of his main industrial policies: the size and impact of the 'marketing board' food price wedge or virtual export tax on commodities, the size and use of 'marketing board' and land tax revenues for infrastructure investment, the size and impact of the 'marketing board' price wedge in supplying cheap intermediates to manufacturing, the off-setting impact of rising nominal labor costs as the 'marketing board' supplied more expensive foodstuffs to urban workers, and the

effectiveness of his non-tariff barriers in keeping out foreign competition. Whether these policies transformed the Egyptian economy is another matter entirely, and not explored here.

A Three-Sector Model of Egypt with and without Ali's Interventions

While we will never have sufficient data to implement some elaborate model of the 19th century Egyptian economy – and thus to assess precisely the impact of Ali's policies on industrialization, the simple model which follows should at least help organize our thinking and lay out an agenda for the needed evidence. In that spirit, we offer below a neo-Ricardian model of industrialization and de-industrialization, with and without Ali's intervention, to get a clearer notion of what should have been the result. Then we can ask: did his state-led policies matter compared to some laissez faire policies?

Without Ali: A Late 19th Century Pro-Global and Pro-Market Egypt

In order to formalize our intuitions about industrialization and de-industrialization in Ali's time, we use a simple neo-Ricardian model (Clingsmith and Williamson 2005; Dobado, Gomez and Williamson 2008; Pamuk and Williamson 2011). Before we complicate the model with Ali's state-led interventions, we start with the simple basics of the late 19th century post-Ali pro-global and pro-market economy.

Consider a perfectly competitive economy in which there are three sectors: textiles, the manufacturing importable (T);⁹ cotton, the commodity exportable (C);¹⁰ and non-tradable

⁹ Textiles were the canonical import-competing activity in Egypt, as in all other emerging industrial economies. First, they dominated import values. For example, in 1861 textiles accounted for more than 60% of total Egyptian

foodstuffs (F). We assume that textiles and cotton are traded in world markets and sell for the world prices p_T and p_C , respectively,¹¹ while p_F is determined endogenously by local supply and demand. Labor (L) is mobile between all three sectors, is the only factor of production, and costs a nominal wage w per unit. As in all simple Ricardian models, we abstract from capital and land,¹² but in any case we do not need either of them to make our point. Finally, when we talk about a decrease in L_T , we refer to this contraction in textile employment as absolute de-industrialization. If we were to also talk about a decrease in L_T/L , we would refer to this contraction in the textile employment share as relative de-industrialization. To simplify, we will always be talking about absolute industrialization or deindustrialization in what follows.¹³

To create a link between agricultural food productivity and wages in the textile sector, we follow Lewis (1954, 1978) in assuming that the real wage in food units was constant, at least in the short run and medium term. The Lewis assumption may, of course, have been violated in the long run, but all that we require is that it was quite sticky in the short run and medium term. The Lewis assumption implies the possibility of underemployment or unemployment, so L represents employment rather than the population, which we denote by P .

imports from the United Kingdom (Owen 1969: Table 13, 108). Second, they employed by far the largest share of the Egyptian industrial labor force.

¹⁰ By 1879, after the ‘cotton famine’ produced during the US civil war, cotton and cotton seed export values were more than 77% of total Egyptian export values. The export mix was very different only three decades earlier. Thus, wheat exports from Alexandria (in value) were 1.7 times cotton exports in 1848 (Owen 1969: Table 26, 170). The ratio must have been even higher in 1800. Indeed, Rome viewed Egypt as its bread basket.

¹¹ That is, p_T and p_C are assumed to be exogenous to the Egyptian economy. While this is certainly a defensible assumption for textiles, what about the fact that Egypt was a significant supplier to world cotton markets by the late 19th century? In fact, Egypt supplied only about 4% of world cotton production in 1860 (having appeared there commercially in 1822) and still only 7% in 1908. The United States determined world cotton prices, not Egypt (Surdam, 1998; Wright, 1974).

¹² It must be added that that we do not totally abstract from capital and labor. Land (and irrigation) is embedded in the productivity shifters in the food and commodity production functions (F and C), and the same is true for capital in industry (T). But these shifters are taken as exogenous and specific to the sectors.

¹³ The algebra gets more complex when we talk about relative industrialization or deindustrialization (in three sectors, one has to worry about employment in C), while the insights gained are modest.

Suppose gross output in each sector is produced according to a Cobb-Douglas production function:

$$Y_F = FL_F^\alpha \quad (1)$$

$$Y_C = CL_C^\beta \quad (2)$$

$$Y_T = TL_T^\gamma C_T^\delta \quad (3)$$

where F, C, and T are technology parameters (or include the impact of omitted endowments, like industrial machinery, arable land and irrigation canals) and C_T is the quantity of intermediates used in manufacturing (flax for linens, wool for woolen goods, cotton for cotton goods, pig iron for metal implements, and so on). $Y_T - p_C C_T$ constitutes the value added in industry; the elasticities α , β , and $\gamma + \delta$ are all less than 1 reflecting diminishing returns. The labor market is such that each individual will supply one unit of labor as long as the food wage w/p_F is at (or above) the reservation price of 1. We assume that there is no rationing of labor, so that $L = L_F + L_C + L_T < P$.

Perfect competition in each sector ensures that labor demand will be given by:

$$L_F = \alpha(p_F F/w)^{(1/1-\alpha)} = F^{(1/1-\alpha)} \text{ since } w = p_F \quad (4)$$

$$L_C = \beta(p_C C/w)^{(1/1-\beta)} \quad (5)$$

$$L_T = \gamma(p_T T/w)^{(1/1-\gamma)} C_T^\delta \quad (6)$$

If we assume that there is no technical change, the growth rates (*) of labor demand are

$$L_F^* = 0 \quad (7)$$

$$L_C^* = -(1/1-\beta)(w^* - p_C^*) \quad (8)$$

$$L_T^* = -(1/1-\gamma)(w^* - p_T^*) + \delta C_T^* \quad (9)$$

Since the nominal wage is equal to the price of a unit of food, employment in the village food sector is fixed. An increase in the own wage in textile production (w/p_T) leads to a decline in the number of workers employed there.¹⁴ Thus, employment in industry decreases when the nominal wage in textiles rises, the price of textiles falls, the cotton price rises (raising $p_C C_T$, hence lowering the value added), and/or when more intermediates are available (for example in response to Ali's subsidies for cotton intermediates in manufacturing, which will be discussed later). There are three forces at work here, one foreign and two domestic. First, the own wage in textiles would rise if the world price for its output fell relative to exports (that is, if Egypt's external terms of trade rose). Second, it would also rise if the nominal wage itself rose, induced by an increase in food prices, caused, in turn, by some negative shock to food output productivity. One source of such positive shocks might have been the shift of food production off high yielding hectares to accommodate the expansion of cotton or wheat cultivation, a shift encouraged by booming world commodity prices. Finally, there's the second domestic force which is influenced by the price of, say, cotton used in cotton textile manufacturing. The more expensive is the price of cotton facing textile firms, the lower the value-added in textile production, and the lower employment. In contrast, a rise in manufacturing employment, and industrialization, would take place if the nominal wage fell, if the price of cotton fell, or if the output price rose.

¹⁴ A rise in the own wage in either cotton or wheat production (w/p_C) also leads to a decline in the absolute number of workers employed there.

With Ali: An Early 19th Century Anti-Global, Anti-Market, State-Led Egypt

Muhammad Ali pursued a policy which restricted the import of manufacturers, taxed export commodities, imposed a wedge between the price of food received by farmers and the price of food paid by urban consumers, supplied manufacturing with cheap locally produced flax and cotton, and built irrigation canals. No doubt he did many other things as well, but these are the industrial policies we wish to assess. So, how do we revise our neo-Ricardian model to accommodate Ali's state-led policies?

We now add an equivalent tariff rate on manufactures (t_T), achieved by Ali's non-tariff barriers, which serves to help protect domestic textiles by driving a wedge between local and foreign prices of T. Figure 1 shows the size of the 'tariff equivalent' of the NTB, i.e. the gap between the world price of textiles (subscript W) and the Egyptian price of textiles (subscript A, for Ali), and the restriction on imports that got this result ($ad - bc$). We also add the effect of a virtual export tax (Figure 2) which Ali used to extract revenues (ABCD in Figure 2) from producers of cotton, wheat, and other exportables (t_C). Finally, the same 'marketing board' (Figure 3) now drives a wedge between the producer and consumer price of food (t_F), and collects the revenues (ABCD). These tariff and export taxes imply the following labor demand conditions:

$$L_F = \alpha(p_F[1 - t_F]F/w)^{(1/1-\alpha)} = [1 - t_F] F^{(1/1-\alpha)} \text{ since } w = p_F \quad (4')$$

$$L_C = \beta(p_C[1 - t_C]C/w)^{(1/1-\beta)} \quad (5')$$

$$L_T = \gamma(p_T [1 + t_T]T/w)^{(1/1-\gamma)} C_T^\delta \quad (6')$$

Assuming as before no technical change, but allowing Ali's investment in irrigation to raise F and C, the growth rates of labor demand can be restated, starting with food production:

$$L_F^* = (1/1-\alpha)F^* - (1/1-t_F) dt_F$$

or if t_F was initially zero

$$L_F^* = (1/1-\alpha)F^* - dt_F \quad (7')$$

The labor force in food production declines (by a multiplier more than one) as Ali imposes the price squeeze with his marketing board wedge of t_F , but the labor force in food production is increased (by a multiplier more than one) if Ali then invests some of the marketing board proceeds in irrigation, raising F . The net impact of these offsetting policy forces cannot be determined without knowing the food supply price elasticity, how much of the marketing board revenues (from both t_F and t_C) was allocated to irrigation, the impact of irrigation on production, and whether the new irrigation favored export crops or food production. But one thing is certain: any net decline in L_F should have served by itself to raise the price of food in urban markets, to put upward pressure on the nominal wage in manufacturing, and thus to diminish domestic manufacturing profitability and competitiveness.

Now consider labor demand in cotton and textiles:

$$L_C^* = - (1/1-\beta) (w^* - p_C^*) + (1/1-\beta) C^* - (1/1-t_C) dt_C \quad (8')$$

$$L_T^* = - (1/1-\gamma) (w^* - p_T^*) + \delta C_T^* + (1/1+t_T) dt_T \quad (9')$$

Labor in the commodity export sector C declines if its own wage rises (pushed up by falling food production and rising food prices) and if the export tax rises (responding to the bigger price squeeze), but it increases if new irrigation infrastructure raises commodity output. Labor in textiles declines if the own wage in textiles goes up (again, pushed up by falling food production and increasing food prices) but it rises in response to a larger quantity of intermediates, lower raw cotton prices (increasing the value added in textiles) and more protection in manufacturing.

The Likely Effects of Ali's State-Led Policies

Overcoming the Terms of Trade and Deindustrialization Threat

Figure 4 plots the Egyptian net barter terms of trade (P_X/P_M) from 1796 to 1850. P_X is the Egyptian export trade weighted average of world prices for its key exports of beans, corn, rice, and wheat up to 1820, and of those four plus cotton prices thereafter (after which cotton became commercially viable).¹⁵ P_M is simply the British export price index, a proxy commonly used in estimating early 19th century terms of trade performance for members of the poor periphery when their import data are scarce.

Ali could not have predicted the terms of trade boom given that there had been no growth in Egypt's terms of trade over the decade prior to his becoming Pasha (Figure 4). But during Ali's time, the Egyptian terms of trade rose by a huge 4.9 percent per annum between 1805 (1804-1806 average) and 1849 (1848-1850 average), his years of rule, and by 3.8 percent per annum between 1812 (1811-1813 average) and 1840 (1839-1841 average), when his state-led policies were dominant. These are very big terms of trade booms by any standard: the figure for the poor periphery as a whole (Figure 5) was 'only' 1.4 percent per annum between 1782 and 1861 and 2.5 percent per annum for Ottoman Turkey between 1800 and 1857 (Williamson 2011: Table 3.1). To the extent that a booming terms of trade had a powerful deindustrialization impact on 19th century Mexico, British India, Ottoman Turkey, Indonesia, the Philippines and the rest of

¹⁵ Long-staple cotton was introduced by the government of Muhammad Ali as a major crop in 1820: it was also called *Jumel*, from the name of the French textile engineer (Louis Alexis Jumel) who discovered it in a Cairo garden, or Mako, after the name of the garden's owner. Jumel was working for the Pasha as the director of a project for the construction of a spinning and weaving mill at Bulaq (Owen 1969: 28). Before 1820 only short staple cotton was cultivated for domestic use, and was not exported.

the poor periphery exporting commodities (Williamson 2011: Chps. 4 and 5), the deindustrialization threat facing Ali was at least twice as great.

It follows that had Ali not intervened, Egyptian industry would have been wiped out during his regime. Thus, had his policies simply saved domestic manufactures from destruction, it would have been achievement enough. If instead those policies actually fostered some industrial development, it would have been even more impressive given the size of the deindustrialization threat he faced throughout his regime. Since we know some industrialization did take place, it *was* even more impressive. Now, exactly what role did his policies play?

The Non-Tariff Barrier Offset

Ali used non-tariff barriers as one device to fend off the deindustrialization threat. Figure 1 helps us think about the magnitudes involved. Without his non-tariff barriers, the world price of manufactures P_{TW} was consistent with Egyptian imports = ad. If Ali's non-tariff barriers drove imports down to bc, then the domestic price of manufactures would have been much higher at P_{TA} , and domestic supplies would have risen from a to b. How much higher must both domestic prices and production have been to have been consistent with the much lower imports, bc? Absent data on actual domestic prices and/or counterfactual imports without those non-tariff barriers, we cannot say, but the price gap between domestic and world manufactures must have been very big (here, $P_{TA} - P_{TW}$), unless, of course, Ali's manufacturing intermediate subsidies shifted the manufacturing supply curve outward to the right, an important policy event described below.

The 'Virtual' Export Tax

Figure 2 describes Ali's 'virtual' export tax on cotton, flax, rice and other export commodities sold on world markets. It assumes that Egyptian export supplies had little impact on world price (P_{CW}), a plausible assumption given that Egyptian cotton accounted for only 4 percent of world cotton exports as late as 1860 and about zero in 1820, and given that the figures were also very low for wheat, maize, and rice. Thus, the state 'marketing board' selling price must have been the world market price, P_{CW} , while the lower 'marketing board' buying price was P_{CB} , implying a 'virtual' export tax $t_c = (P_{CW}-P_{CB})/P_{CB}$. Revenues accruing to the state were the area ABCD.

There was, of course, a disincentive facing commodity producers at the lower buying price, so exports must have fallen from X_W to X_B *ceteris paribus*. We say *ceteris paribus* since Ali used these and other revenues in part to build irrigation and transport infrastructure, thus serving to shift the supply function to the right. Which dominated – backward movements along export commodity supply functions, or outward shifts in those supply function? We need more information to guess at the answer.

Consider the commodity export supply function first. We display 'marketing board' buying and selling price quotes in Table 1. On average, t_c was a very large, 176 percent. If the supply elasticity was about unity (Wright 1974), then the movement down the supply function diminished amount supplied by around 176 percent. However, we know that Ali limited the ability of producers to shift crop mix in response to the marketing board's low prices (Rivlin, 1961), so the reduction in supply would have been limited to diminished labor input, water application, fertilizer use, and animal power. Let's say that the diminution of commodity export supply through price disincentives was only an eighth or a tenth of that implied by unitary elasticity, or about 18-22 percent. So, which dominated the amount of exports supplied to world

markets – backward movements along export commodity supply functions, or outward shifts in those supply functions? Regarding the latter, consider Ali’s investment in irrigation and transportation. The improvement of the irrigation system played a crucial role among the agricultural policies that the Pasha put into effect. Before Ali, Egypt relied on the so called ‘basin irrigation system’, consisting of dikes surrounding the cultivated areas, forming basins into which the Nile’s flood water accumulated so that the silt was absorbed into the soil. The Nile flooded between mid-July and October, thus implying that crops were produced only once a year (winter crops): after harvesting in April, the land remained fallow.¹⁶ Ali changed the very basis of this irrigation system through the introduction of a ‘perennial irrigation system’ which allowed crop growing throughout the year. This involved the digging of deeper canals, the extension of the existing canal network, the strengthening of dikes and the establishment of *saqiya*s, water-raising devices.¹⁷ The major technological improvement necessary for the success of the perennial irrigation system was the construction of barrages, used to store the excess water from the Nile, to be distributed for the cultivation of the summer crops, the most important of which was long staple cotton.¹⁸ Table 2 reports some of Ali’s investments in agriculture and their share of total expenditure. It suggests that on average at least 18 percent of the annual budget was allocated to agricultural infrastructure; moreover, Rivlin (1961: 286) reports that an average of 2,799,140 francs was spent annually for building locks, weirs, barrages and dikes, which represented an additional 4.7 per cent of annual state expenditures.¹⁹ Since

¹⁶ Summer crops, like short staple cotton, could be planted only in lands provided with irrigation facilities when the Nile was low, but these were scarce (Ishida 1972: 171).

¹⁷ *Saqiyah*s were used for lifting the water from the canals during summer, the period of cotton cultivation, when the level of the Nile was at its lowest point (Rivlin 1961: 138). In 1840 there were around 50,000 *saqiya*s in the Lower Delta, of which Ali built at least 38,000 (Ishida 1972: 172).

¹⁸ Most of the labor necessary for the improvement of the irrigation system was provided by *corvée*.

¹⁹ Average yearly government expenditure between 1821 and 1838 was 59,050,179 francs. (Authors’ calculations based on Owen 1969: 43.)

there was little or no such investment prior to Ali's rule, then such investment must have risen by some 23 percent. This, of course, ignores all investments made by unpaid corvée labor (Owen 1969: 22-81), but we do know that the area of cultivated land increased by 26.2 percent between 1813 and 1840 (Rivlin 1961). We also do not know the impact of these investments on the supply of commodity exports like cotton, but under the assumptions of equation (1), supply would also have shifted out by the same 26 percent or so. Thus, Ali's virtual export tax generated large revenues which, augmented by corvée labor, supported his infrastructure projects. But these export tax revenues came at some cost to export expansion due to farmer disincentives: low 'marketing board' buying prices causing backward movement along the supply curve (18-22 percent) was probably almost as big as the outward shift in supply due to the infrastructure investments (26 percent).

If it wasn't the net effect of land expansion, what then explains the boom in Egyptian commodity exports during Ali's time? The answer, of course, was the spectacular boom in commodity prices that we have already documented above.

The Manufacturing Intermediate Subsidy

Expression (6') stresses the important distinction between manufacturing gross output and value added, the difference being intermediate costs (flax for linen, cotton for cotton textiles, pig iron for metal implements, and so on). The share of intermediate costs in total costs is denoted by θ_{CT} . Since Ali appears to have supplied his manufactures with cotton, flax and other intermediates at the lower 'marketing board' buying price, the cheaper intermediates must have raised their value added and competitiveness. In short, Egyptian industry was made more

competitive by this subsidy, since foreign producers had to pay the unsubsidized world price for those intermediate commodities.

How big was Ali's subsidy? Taking the price of textile output as fixed, then the subsidy t_s was a function of the marketing board price wedge (on average 136 per cent for cotton and flax, see Table 1) and the cost share θ_{CT} . Bowring (1840, p. 40) supplies production costs for yarn production at Ali's Kurnofish factory, where the raw cotton and labor cost shares averaged, respectively, 58.5 and 28.8 percent. Thus, the intermediate subsidy to textile manufacturing in Ali's time was huge, $t_s = (0.585)(1.36) = 80$ percent. Indeed, the intermediate subsidy was probably big enough to have made Egyptian manufactures competitive with foreign manufactures even without his non-tariff barriers!

The Food Price Squeeze: the Revenue and Urban Wage Cost Trade-Off

In contrast with so much of the contemporary Third World, Ali's 'marketing board' bought foodstuffs low in the village, and sold them high in the towns and cities. This would have served to have lowered the real wage in manufacturing unless the nominal wage rose in response. Table 3 illustrates the price wedge for the main food items of the *fellahin* consumption basket, while Figure 3 describes the behavior of food markets. The 'marketing board' buying price is P_{FB} , the selling price P_{FS} , the mark-up $t_F = (P_{FS} - P_{FB})/P_{FB} = 89$ per cent, and the state revenue is $ABCD$. Given a pre-marketing board price P_F , the market price of food rises by $(P_{FS} - P_F)/P_F = t_F/2 = 44.5$ per cent (assuming demand and supply elasticities in Figure 3 are both unitary).²⁰ Thus, to keep manufacturing real wages constant, Ali would have had to raise nominal wages by 44.5 per cent. It appears that he did not, since there is plenty of evidence suggesting that urban

²⁰ Batou (1991: 64) suggests that farmers could sell their surplus only to the state, which paid them around 50 percent of the market price.

manufacturing wages were stable (on average at 3.625 piastres per day for urban workers). But grain sale prices rose, and thus real grain wages fell under Ali's rule (see Table 4). In fact, it appears that grain wages fell by about 44 percent on average between 1812 and 1835. Since nominal wages were stable during most of Ali's regime, it follows that manufacturing costs were not raised on that account.

Thus, it appears that Ali was able to generate considerable revenue ABCD, something we can estimate simply by multiplying price wedges ($P_S - P_B = CB$) times production (AB). We have the price wedge and production reports from the early 1820s to the mid 1830s for wheat, beans, lentils, barley and maize (Rivlin 1961: 137-158).²¹ The figures, reported in Table 5, are consistent with independent reports of Ali's monopoly revenues (Issawi 1966: 385; Owen 1969: 42-3). We conclude that Ali raised considerable revenues from his food 'marketing board' policies at little or no loss in manufacturing competitiveness (but perhaps at considerable human cost).²²

The Ultimate Assessment

Western historiography has generally considered Muhammad Ali's industrialization experience as a failure.²³ Our assessment is much more positive and aligns itself with Batou's evaluation, describing Ali as a 'roi industriel' (Batou 1990: 94). The analysis and evidence offered in this paper allowed us to assess Ali's economic policies, suggesting that they had a clearly positive impact on industrialization, despite Egypt's very low level of import duties and a

²¹ We calculate the quantity used in the domestic market AB by subtracting export from total production.

²² An average of 100,000 or 3 percent of the whole population was used as *corvée* and served in the armed forces (Issawi 1982: 104).

²³ For example, Landes (1991: 59) describes Ali's industrialization effort as "a project that was doomed from the start and already in its death rattle." Along the same lines, Herschlag (1964: 90) writes: "Most of Mehmed Ali's experiments in the field of social reforms and economic development were doomed to failure." See also Bowring (1840).

de-industrializing commodity price boom that exceeded that of all other countries in the poor periphery. Indeed, Egypt was the only state in the poor periphery which tried to build up an industry in the first half of the 19th century.

Muhammad Ali's policy of forced industrialization -- achieved through the virtual nationalization of the Egyptian economy and the expropriation of the landed aristocracy's wealth and agricultural surplus -- generating the revenue to finance the capital accumulation necessary for industrial development.²⁴ With the state acting as a major consumer and as the sole buyer and supplier of key commodities (through the establishment of monopolies and the control of trade), Ali promoted a policy based on agricultural and transport investments, on generous subsidies to domestic manufacturing and on industrial protection through non-tariff barriers. This enabled Egypt's transformation from a primarily agrarian society²⁵ to an early industrializer with an expanding industrial sector, mainly based on textile manufacturing,²⁶ but also including food processing, corn grinding, rice hulling, coffee roasting, sugar refining -- the usual activities in which the newly industrializing countries excel (even the United States during Ali's time), and also small metallurgy, engineering and chemical industries.

Undoubtedly, Egypt's industrialization under Ali involved heavy human cost, and the *fellahin* had to carry most of the burden of it. However, it is important to stress that farmers' living conditions were also deplorable under the Mamluks (before Ali). Nor did they improve in the decades after Ali's rule: living standards improved only temporarily during the so called

²⁴ According to Issawi (1982: 188) the level of capital accumulation was as high as 10 percent of GDP during the Pasha's rule, very high by the standards of that time. Indeed, W. A. Lewis (1954) famously stated that the key to industrial success was to raise the investment share from 5 to 12 percent, pretty much Ali's achievement.

²⁵ Rivlin (1961: 61) defines pre-Ali Egypt as "a huge government farm managed by state functionaries."

²⁶ The cotton spinning and weaving sector was made of nearly 30 spinning mills, each with 15,000 spindles on average, employing around 15,000-20,000 people (Batou 1991: 184). Egypt's textile output was consumed not only domestically, but also exported: particularly important were yarn exports to Turkey, Syria, Sudan, Austria and Italy.

‘cotton famine’ at the height of the American Civil War,²⁷ but they worsened soon afterwards when peasants were squeezed by a combination of falling prices and rising taxes (Issawi 1982: 105). Furthermore, not all Western observers painted a gloomy picture of Ali’s Egypt. Some perceptive travelers reported that the *fellahin* living standards were similar and sometimes even better than those of Swiss, Irish, Scottish, Spanish and Greek landless laborers and even small farmers.²⁸

Ali’s state-led experiment needs to be assessed within its historical environment. Our analysis has tried to do so, and it provides a very clear image of the magnitude of Ali’s policies and their impact on industrial development. Despite embodying a model of industrial development radically different from the standard *laissez-faire* ideology emerging in 19th century western Europe and its offshoots, Ali’s effort was successful from a strictly economic point of view. After his state-monopoly system was dismantled and his state-led industrial policies were reversed, Egypt had to wait another hundred years before modern factories would appear again along the banks of the Nile.²⁹

²⁷ See Panza (2012a) for a description of the impact of the American Civil War on the Egyptian economy.

²⁸ See Scott (1837: II, 176), Cooley (1842-A: 167 and 174), Pückler-Muskau (1844: 50) and Waghorn (1837: 18) all quoted in Batou (1990: 65).

²⁹ It was not until the 1930s that industrial employment began to grow considerably in Egypt (Issawi, 1982, p. 150).

References

- Allen, R. C. (2009), *The British Industrial Revolution in Global Perspective* (Cambridge: Cambridge University Press).
- Batou, J. (1991), "Muhammad Ali's Egypt. A Command Economy in the 19th Century?" in J. Batou (ed.), *Between Development and Underdevelopment. The Precocious Attempts at Industrialization of the Periphery, 1800-1870* (Geneva: Centre of International Economic History, University of Geneva), pp. 181-218.
- Batou J. (1990), *Cent ans de résistance au sous-développement. L'industrialisation de l'Amérique latine et au Moyen-Orient face au défi européen, 1770-1870* (Genève: Centre d'Histoire Économique Internationale).
- Cadalvene, E. and J. Breuvery (1841), *L'Égypte et la Nubie*, 2 vols (Paris).
- Clingingsmith, D. and J. G. Williamson (2008), "Deindustrialization in 18th and 19th century India: Mughal Decline, Climate Shocks and British Industrial Ascent," *Explorations in Economic History* 45 (July): 209-34.
- Dobado Gonzáles, R., A. Gómez Galvarriato, and J. G. Williamson (2008), "Mexican Exceptionalism: Globalization and De-Industrialization 1750-1877," *Journal of Economic History* 68 (September): 1-53.
- Douin, G. (1927), *La Mission du Baron Boisecomte: l'Égypte et la Syrie en 1833* (Le Caire: Société Royale de Géographie d'Égypte).
- Fahmy, M. (1954), *La Révolution de l'industrie en Égypte et ses conséquences sociales au 19^e siècle, 1800-1850* (Leiden: Brill).

- Gerschenkron, A. (1962), *Economic Backwardness in Historical Perspective* (Cambridge, Mass.: Harvard University Press).
- Gliddon, G. R. (1841), *A Memoir on the cotton of Egypt* (London).
- Herschlag, Z. Y. (1964), *Introduction to the Modern Economic History of the Middle East* (Leiden: Brill).
- Ishida, S. (1972), "Delta barrages and Egyptian economy in the Nineteenth Century," *The Developing Economies*, 10 (June): 166–184.
- Issawi, C. (1966), *The Economic History of the Middle East, 1800-1914* (Chicago and London: The University of Chicago Press).
- Issawi, C. (1982), *An economic history of the Middle East and North Africa* (New York: Columbia University Press).
- Landes, D. (1991), "Does it pay to be late?" in Batou J. (ed.), *Between Development and Underdevelopment. The Precocious Attempts at Industrialization of the Periphery, 1800-1870* (Geneva: Centre of International Economic History, University of Geneva), pp. 43-66.
- Lewis, W. A. (1954), "Economic Development with Unlimited Supplies of Labour," *Manchester School of Economics and Social Studies* 28 (2): 139-91.
- Lewis, W. A. (1978), *The Evolution of the International Economic Order* (Princeton, N. J.: Princeton University Press).

- Marsot, al-Sayyid A. L (1984), *Egypt in the reign of Muhammad Ali* (Cambridge: Cambridge University Press).
- Owen, E. R. J. (1969), *Cotton and the Egyptian Economy 1820-1914* (Oxford: Oxford University Press).
- Owen E. R. J. (1981), *The Middle East in the World Economy* (London: Methuen).
- Pamuk, Ş. and J. G Williamson (2011), "Ottoman De-Industrialization 1800-1913: Assessing the Shock, Its Impact and the Response," *Economic History Review* 64. S1 (February Special Issue 2011): 159-184.
- Panza, L. (2012a), "Globalisation and the Near East: A study of cotton market integration in Egypt and Western Anatolia," La Trobe School of Economics Working Paper Series, 1/2012 http://www.latrobe.edu.au/_data/assets/pdf_file/0013/181300/2012.01.pdf
- Panza, L. (2012b), "De-industrialisation and re-industrialisation in the Middle East: reflections on the cotton industry in Egypt and Western Anatolia," CEH Working Paper, ANU <http://cbe.anu.edu.au/research-papers/wpceh/deindustrialisation-and-re-industrialisation-in-the-middle-east-reflections-on-the-cotton-industry-in-egypt-and-western-anatolia/>
- Raymond, A. (1973-4), *Artisans et commerçants au Caire au XVIII siècle* (Damascus: IFEAD).
- Richards, A. (1982), *Egypt's agricultural development, 1800-1980* (Colorado: Westview Press)
- Rivlin, H. E. B. (1961), *The agricultural policy of Muhammad Alī in Egypt* (Harvard University Press).

Surdam, D. J. (1998), "King Cotton: Monarch or Pretender? The State of the Market for Raw Cotton on the Eve of the American Civil War," *The Economic History Review*, 51, No. 1 (February): 113-132.

Tucker, J. E. (1985), *Women in nineteenth-century Egypt* (Cambridge: Cambridge University Press).

Williamson, J. G. (2011), *Trade and Poverty: When the Third World Fell Behind* (Cambridge, Mass.: MIT Press).

Wright G. (1974), "Cotton Competition and the Post-Bellum Recovery of the American South" *Journal of Economic History* 34 (September): 610-35.

Figure 1: Non-tariff barriers in the textile sector

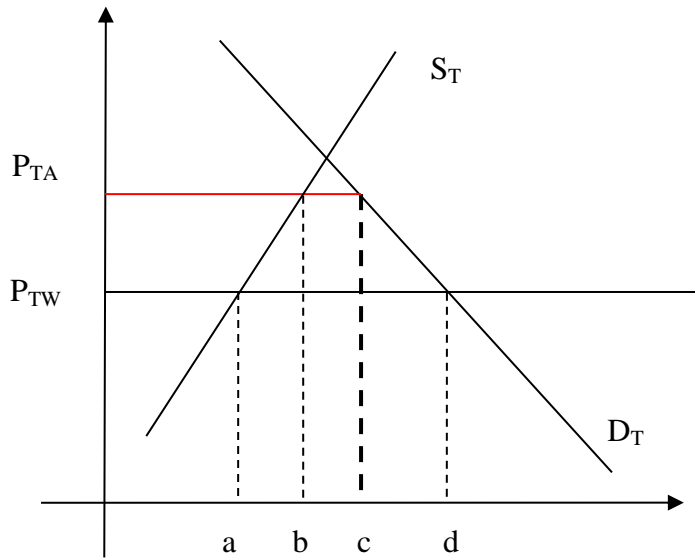


Figure 2: The 'virtual' export tax

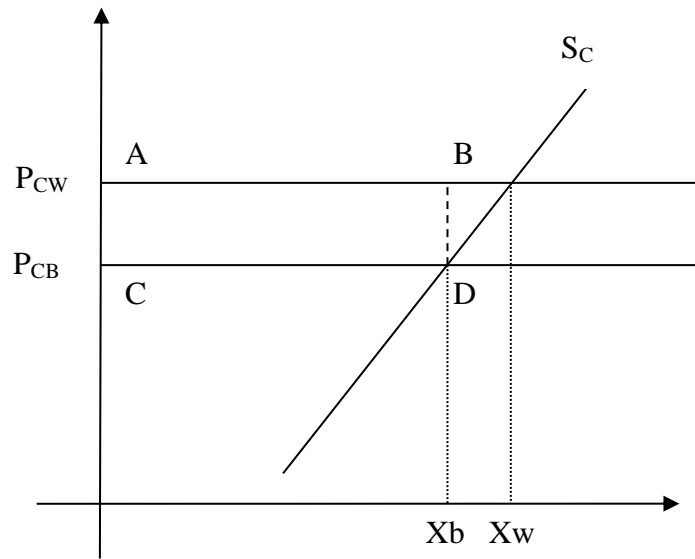


Figure 3: Marketing board in the food sector

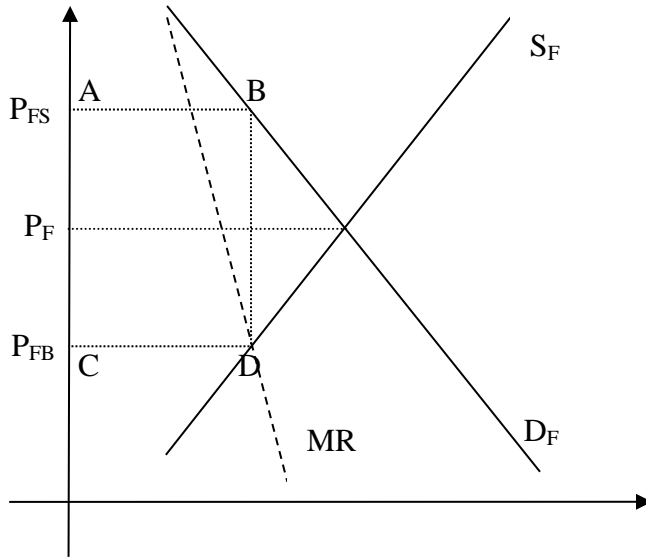
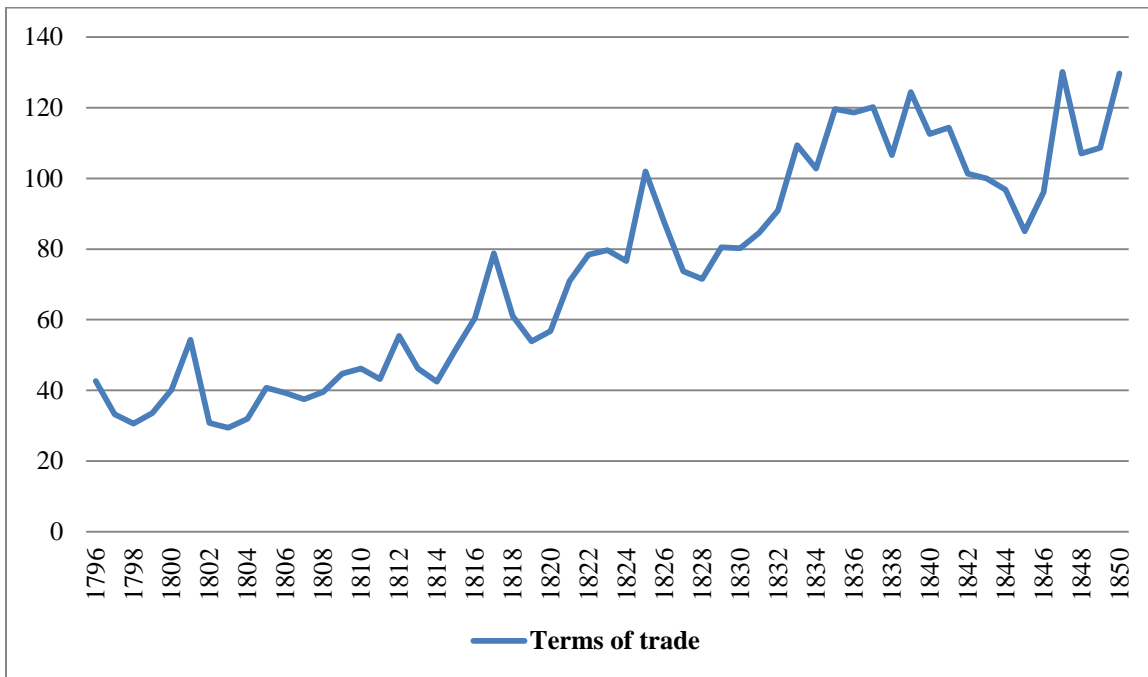


Figure 4: Egyptian Terms of Trade, 1796-1850

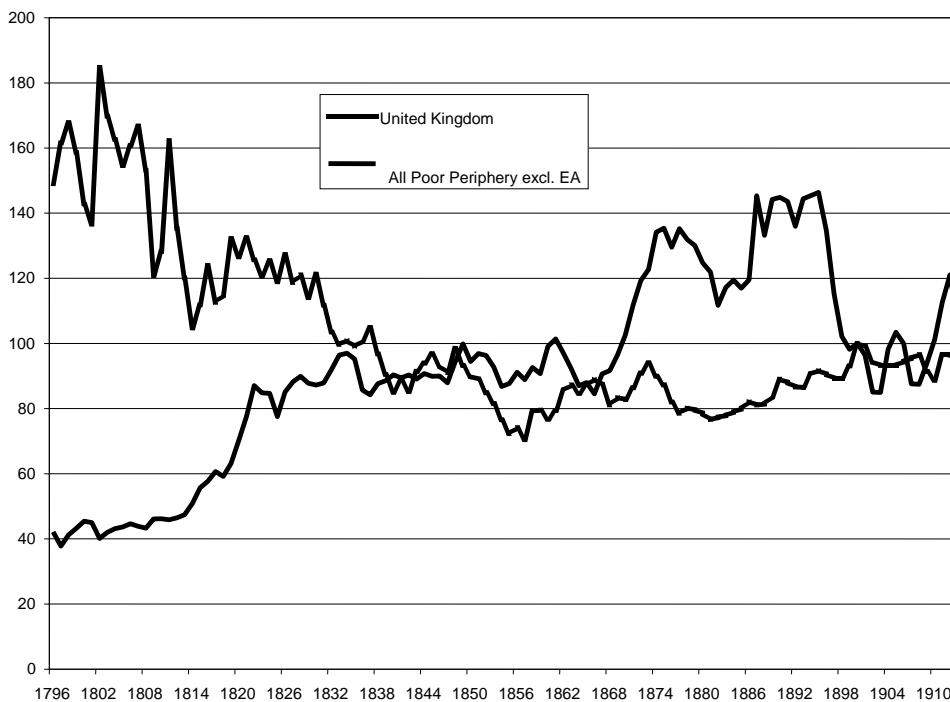


Notes on Prices: From 1796 to 1820 export prices include peas (serving as a proxy for beans), corn, wheat and rice. From 1821 to 1850 export prices also include cotton. For the whole period, import prices are the British export prices.

Sources for Prices: Anne Bezanson, Robert D. Gray and Miriam Hussey, *Wholesale Prices in Philadelphia 1784-1861: Part II - Series of Relative Monthly Prices* (Philadelphia: University of Pennsylvania Press, 1937); Mitchell and Deane, *Abstract of British Historical Statistics* (Cambridge: Cambridge University Press, 1962, p. 331).

Notes and Sources on Weights: The weights 1796-1820 are: beans (0.42), corn (0.036), wheat (0.45), rice (0.09), from Rivlin (1961: 157). The weights 1821-1850 are: beans (0.11), corn (0.09), wheat and barley (0.13), rice (0.12), cotton (0.54), and from Owen (1969: 170).

Figure 5: United Kingdom versus the Poor Periphery: Net Barter Terms of Trade, 1796-1913



Sources: Williamson (2011: Figure 3.2).

Table 1: Ali's 'marketing board' buying and selling price for exportables

Commodity	Year	Selling price index	Buying price index	$t_c = (P_W - P_B)/P_B$
Wheat	1830	321	100	2.21
	1832	480	100	3.8
	1833	214	100	1.14
Cotton	1822	182	100	0.82
	1830	250	100	1.5
	1833	250	100	1.5
	1835	275	100	1.75
	1836	200	100	1
Maize	1830	388	100	2.88
	1833	371	100	2.71
Broad beans	1830	256	100	1.56
	1833	250	100	1.5
Flax	1830	243	100	1.43
	1833	242	100	1.42
Barley	1830	256	100	1.56
	1833	250	100	1.5
Peas	1830	206	100	1.06
	1833	214	100	1.14
Rice	1830	303	100	2.03
	1833	266	100	1.66
Sugar	1830	376	100	2.76

Sources: Douin (1927); Cadalvène and Breuvery (1841); Rivlin (1961).

Table 2: Ali's investment in irrigation and its share of Egypt's yearly expenditure (values in purses)

Year	Investment	Cost	Total expenditure	%
1817-1820	Mahmoudiyah	35,000	189,400	18.5
	Canal			
1836	Sarawah canal	20,000	575,200	3.5
	Irrigation	130,000		
1840	Nile Barrages	58,705	720,000	8.15
	Bahr Shibin canal	10,000		

Sources: Rivlin (1961); Owen (1969); Bowring (1840); Marsot (1984).

Table 3: Ali's mark-up in the domestic food market

Commodity	Year	Selling price index	Buying price index	$t_c = (P_W - P_B)/P_B$
Wheat	1812	240	100	1.4
	1830	200	100	1
	1833	192	100	0.92
Dourah	1830	175	100	0.75
	1833	186	100	0.86
Broad beans	1830	178	100	0.78
	1833	185	100	0.85
Barley	1830	178	100	0.78
	1833	185	100	0.85
Peas	1830	176	100	0.76
	1833	186	100	0.86

Sources: Douin (1927); Cadalvène and Breuvery (1841); Rivlin (1961).

Table 4: Egyptian wages, 1812-1835

Year	Daily wages (piastres)		Wheat sale prices (piastres per <i>ardabb</i>) ³⁰	Urban factory Grain wages
	<i>Farmers</i>	<i>Skilled (urban)</i>		
1812	1		100	0.036
1821	1		85	0.043
1822	1		200	0.018
1827		2-3	85	0.043
1828	1		200	0.018
1829	1			
1830	2-3			
1831		2-6	175	0.020
1832	3-5*		120	0.030
1833	1-2	4		
1834	2-3			
1835		2-6	175	0.020

* High agricultural wages owing to labor shortages due to high levels of military conscription in the Syrian war.

Sources: Gliddon (1841); Rivlin (1961); Fahmy (1954); Tucker (1985); Batou (1991); Marsot (1984); Issawi (1966); Marsot (1984).

³⁰ One *ardabb* of wheat was equal to 150 kg (Richards 1982: xiii).

Table 5: Ali's monopoly revenues in the domestic market, in thousand Egyptian piastres, 1821-1835

Commodity	1821	1830	1832	1834	1835
Wheat	63,966	58,000	117,034	53,500	76,707
Beans	25,723	4,633	22,489	18,240	14,248
Lentils	3,223	248	2,097	1,111	904
Barley	11,157	812	16,977	10,202	10,966
Maize	9,345	622	16,981	11,570	10,431

Sources: Authors calculation based on Rivlin (1961: 137-158) and Batou (1991: 192). The exchange rate pound sterling/ Egyptian piastres follows Batou (1990: Annexe A). The conversion quintal/*ardabb* is taken from Richards (1982: xiii).