

Looking ahead from the past: The inter-temporal sustainability of Portuguese finances, 1854–1910

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The history of public finances in Portugal from the middle of the nineteenth century to World War I is distinguished by the pursuit of an ambitious programme of public investment in infrastructure, and by the negative financial consequences this elicited, culminating in the 1892 default. In this article we approach the Portuguese financial history of this period with a relatively new methodology for evaluating financial sustainability, which emphasises the inter-temporal nature of government budgeting. The results obtained allow us to quantify the distance that separated Portuguese finances from a sustainable path throughout the period. Although the generational imbalance of Portuguese finances at the time seems massive in the context of today's benchmarks, its economic and financial impact should have been more limited, given the government's relatively low weight in the economy and the favourable demographic pattern.

1. Introduction

The historiography of the relative failure of Portuguese economic growth during the second half of the nineteenth and the first decades of the twentieth centuries usually considers the economic role of the state and the impact of its financial arrangements. In his classic study, Reis (1984) considered this as one of the possible explanations of Portuguese economic backwardness before World War I. According to Tortella (1999), financial disorder could even be considered as a trait of a specifically 'Latin' pattern of development, in which he included the contemporary cases of Portugal, Spain and even Italy. The average judgement, on this account, is pessimistic, and in the case of Portugal echoes a traditionally negative appraisal

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of the state's economic effects, dating from the late nineteenth century (on this, see Sousa 1983).

In this article we will try to offer a new quantification of the degree of financial disorder that prevailed in Portugal from the middle of the nineteenth century to the end of the Monarchy, in 1910. To be sure, the retrospective financial statistics gathered by Mata (1993) for the period 1851–1913 were a decisive contribution to this debate, which had previously suffered from the lack of a coherent set of data on budgets and debt. However, the traditional measures of budget deficits or debt accumulation have been long criticised as inaccurate measures of the inter-temporal economic impact of government. This is all the more relevant for the history of Portuguese public finance during this period because the financial strategy inaugurated in the early 1850s specifically targeted a long-run objective of financial sustainability, while sacrificing short to medium-run budget balance. In this context, static measures of budget deficits are not adequate in themselves to evaluate the degree of success of such a policy.

For these reasons we try to apply a different accounting method, called 'generational accounting', that has distinctive theoretical advantages over traditional measures. We compute the 'generational accounts' of the period 1854–1910 that broadly correspond to the long-term financial strategy adopted by Portuguese governments and to its aftermath, in the wake of the 1891–93 financial crisis.

In Section 2 we summarise the main facts regarding Portuguese government finances during our period of study. Section 3 then defines the concept of generational accounts and outlines its implementation to our case study. Section 4 condenses the quantitative results and subjects them to a sensitivity analysis. The last section collects the main findings and makes some final comments.

2. From *améliorations matérielles* to default

For the inaugural lecture of the course of political economy held at the *Collège de France* during the academic year of 1844–45, Michel Chevalier chose the topic of public finances. According to him, public indebtedness was advisable for a government

that wanting to use the amenities of peace, has decided to achieve vast improvements with a short delay, and that follows the maxim that the most economical government is not the one that spends less but the one that spends the best . . . For it to be so, governments only have to make use of . . . loans with a view to public interest, when the circumstances indicate that it is present; and in our times, with the passion for material improvements [*améliorations matérielles*], quickly achieved, that distinguishes the age, nothing is easier than to find such occasions (Chevalier 1855, pp. 96, 104).

This kind of support for a greater burden of government enterprise whenever the benefits in terms of public interest overpowered the traditional dictums of ‘sound finance’ has a distinct Saint-Simonian flavour that swept over continental Europe in the second half of the nineteenth century (Eckalbar 1979 and Fakkar 1968). In Portugal it came to be mainly associated with a period known as *Regeneração* (Regeneration) spanning 1851–68. Although brought to power by a military *coup d’état*, the coalition of forces around the first regeneration government was able to muster a sufficient political consensus for future governments to be able to focus their action on the ‘rapid achievement of material improvements’.¹ The bold economic programme of the *Regeneração* was made up of institutional reforms and large investments in infrastructure (namely in transport and communications) highly subsidised by the state. Both were aimed at the establishment of an adequate basis for the development of market forces, which would in time lead to greater material well-being. The frequent use of the expression *melhoramentos materiais* (the direct Portuguese equivalent of *améliorations matérielles*) in official discourse actually resulted in the economic programme of the *Regeneração* being known by this French-borrowed term. But the programme outlived the *Regeneração* period proper, until the financial stringencies of the 1890s largely put an end to this debt-financed model of development.² For this reason, our study will extend beyond 1868, to encompass the periods both before and after the financial crisis of 1890–92.³

This was, however, not a simple programme to implement for a state whose finances had been systematically in deficit, and which had a record of bad debts at least since the beginning of the nineteenth century. Following the end of the civil war (1833) there were no less than three reschedulings of Portuguese foreign debt (1840, 1845 and 1852), which were equivalent to defaults, except in their form, and frequent delays in the payment of interest, which was usually added to the principal.⁴ Nevertheless, the governments of

¹ It should be noticed that a similar agenda had already been tried by the previous authoritarian administrations of Costa Cabral (1842–46 and 1849–51) but without much success, because of stern political opposition and civil unrest, which contrasts with the political consensus engendered by the *Regeneração*.

² On the economic meaning and achievements of the *melhoramentos materiais* see, among others, Pereira (1979), Cabral (1981), Mata (1988), Justino (1988–89), Nunes *et al.* (1989) and Mata and Valério (1994a).

³ The starting date of our sample is 1854 and not 1851 because the data were originally gathered for another study, for which some other variables were only available from this date on. Still, this is no great loss, because the information available for the beginning of the period is only tentative, and also because until the 1856 settlement with the London exchange, the regeneration government lacked the financial basis to advance its economic agenda.

⁴ The financial burdens of the Napoleonic wars, the loss of Brazil and the civil war played their part in this record, as also did the extremely risky ‘financial engineering’ set up by

the *Regeneração* expected to use debt to raise the monies needed for the *melhoramentos materiais*. This they achieved thanks to an overall surplus of capital available for foreign investment in the main European markets, to which they gained access by means of an agreement directly negotiated with a committee of foreign bondholders in 1856. The question remained: how to service and then pay for this debt? As far as the early supporters of the *melhoramentos materiais* were concerned, the answer seemed almost obvious: 'It is of simple intuition that the timely application of capitals to create public wealth raises average general prosperity and, as an inevitable consequence, is reflected in an increase of government income' (Mendonça 1856, p. 13). In other words, as long as the extra public resources were allocated to the ambitious programme of public works it would be reasonable to expect an increase in national income sufficient to raise the amounts necessary to pay the interest and principal on the long-term debt incurred, without unduly affecting the real tax charge on the economy. As regards the type of debt, long-term debt was preferred to short-term debt, and external debt to internal debt, in order to avoid crowding out the scarce private capital resources of the country.

Despite the sizeable resources gathered by debt and taxes alike (total public revenue during 1854–1890 grew at 3.6 per cent per annum on average, in nominal terms), the achievements of the *melhoramentos materiais* fell rather short of their financial aims. The figures in Table 1 allow us to assess the dimensions of the shortfall.

First of all, in spite of the official priority given to public investment, government current expenditure absorbed the lion's share of all public resources (more than 90 per cent until 1891, according to Mata 1993). Second, public revenue, although growing, could not keep pace with the

Table 1. *Summary statistics of Portuguese finances, 1854–1910.*

Averages	1854–59	1860–69	1870–79	1880–89	1890–99	1900–10
Debt/GDP	38	51	74	81	83	74
% of long term debt	93	94	94	88	68	52
% of external debt	49	48	42	48	51	36
Nominal interest rate	6.9	6.7	6.8	5.4	6	5.3
Real interest rate	2.3	7.0	5.8	6.9	3.4	5.7

Notes: the nominal interest rate is measured by the yield of Portuguese internal consolidated (long term) debt.

Sources: Mata (1993) for debt ratios and Esteves (2000) for interest rates.

the first liberal governments and by Costa Cabral. Although this period in the history of the public finances has not been much studied, see Silveira (1987) and Mata and Valério (1994b).

even faster increase in expenditure, with debt having to make good the difference. In fact, the Portuguese government was entering into a sort of Ponzi-game, with real public debt growing at an average rate of 4.7 per cent per annum with an average real interest rate of 3.02 per cent effectively charged on that debt.⁵ Consequently, the weight of public debt in GDP more than doubled between the early 1850s and 1890. Furthermore, even though the bulk of public debt was long term (consolidated debt), as envisaged in the financial programme of the *Regeneração*, more than half of the borrowing involved internal debt, contrary to the stated purpose of not absorbing national capital. Actually, the share of foreign resources was even smaller, because Portuguese subjects also bought external debt. The total net receipts from Portuguese foreign debt between 1854 and 1890 added up to £ 32.7 m (at par).⁶ Some £ 20.6 m were also gathered from internal debt during the same period. Average nominal interest rates remained closer to 7 per cent with the exception of the 1880s. Real interest rates were also broadly consistent with the size of budget deficits, which were particularly high in the 1860s and 1890s (see Figure 3 below).

The year 1890 brought an end to this state of unsustainable finances, when the European markets closed themselves to the floating of further Portuguese debt. In the short term the government was forced to resort to a partial default by cutting in 1892 the interest on foreign debt to one third of its contractual value, which led to a protracted dispute with its foreign creditors, only resolved in 1902. Despite the fact that 1890 coincided with the global disturbances caused by the Baring crisis, the Portuguese case was singular because never again would the government be able to place its sovereign debt outside its borders, even after the 1902 settlement.

If there is something surprising in this story it is the prolonged access that Portugal had to the main financial markets of the time (first London, and from the 1880s Paris and Berlin, according to Vieira 1983), notwithstanding its previous reputation of being a bad debtor, which the bold financial arrangements of the *Regeneração* actually did nothing to correct. True enough, foreign investors only accepted Portuguese sovereign debt at a considerable discount, but they kept on subscribing to it for almost four decades, despite the growing evidence that Portuguese government was rolling-over its debt. If we take the secondary market's price of Portuguese debt as an indirect indicator of the market's awareness of the likelihood of a default, we perceive that in the last years before the 1890s crisis no such awareness seems to have developed. In fact, between 1886 and 1889 the average price of

⁵ The period of reference is again 1854–1891. The 'effective' interest rate was obtained by dividing the amounts annually appropriated for the service of debt by the total debt outstanding (excluding debt held by the government).

⁶ At least £ 11.5 m were bought by Portuguese subjects, which leaves a net influx of foreign capital of at most £ 21.2 m (calculations by Esteves 2002). We took the par exchange rate of 4500 réis per pound.

Portuguese bonds increased by 33 per cent in London and 29 per cent in Lisbon (data from Vieira 1983 and Esteves 2002).⁷

Portuguese officials and observers were the first to recognise the failure of the *melhoramentos materiais* as a simultaneous solution for growth and financial stability. Accordingly, the new political orientation formed out of the difficult 1890–92 years returned to the ideology of sound finance and balanced budgets. Even if the new goal was too ambitious for the state of public finances, there was a marked retrenchment in public expenditure, which, coupled with some rise in revenue, allowed a reduction of the average deficit from 7,065 *contos* (1860–89) to 3,688 (1890–1910).⁸ This translated into a decrease in the weight of debt in the economy, and also in the interest rate levied on the debt. Furthermore, the 1891 abandonment of the gold standard helped to ease this transition, especially in its first years, when the bulk of the public deficits were financed through the central bank. This explains the decrease in the share of long term debt, which the government could no longer place in foreign markets, nor even in the national market, during the worst years of the crisis. Despite the clamour raised in some quarters by this policy of monetisation, the fact is that it did not bias the money market equilibrium towards an inflationary process (Reis 2000), which also helped the transition between financial strategies.

Be that as it may, the ‘unsoundness’ of Portuguese finances was to remain in force at least until the first decade of the twentieth century. To understand this point we now turn to generational accounting as a means of quantifying how far the Portuguese government financial position was from inter-temporal sustainability, both before and after the 1890s financial crisis.

3. Generational accounts

3.1. *A meaningful alternative to deficit accounting*

As originally described by Auerbach *et al.* (1991), the methodology of generational accounting (GA) was a substitute for the more traditional measures of the government’s budget deficit and debt. ‘Meaningful’ here means ‘with a useful economic meaning’, as gauged by the standard theory of inter-temporal optimisation over the life-cycle. In fact, Auerbach *et al.* (1994, p. 74) emphasise the contradiction that exists between the traditional

⁷ We can think of some plausible explanations for this apparent ‘surprise’ for the markets, namely (1) the political and economical problems in Brazil which suddenly decreased the volume of Portuguese emigrants’ remittances; (2) the boycott imposed by the Paris bourse on Portuguese debt, under pressure from the bondholders of a loan raised by the absolutist government in 1832 and which the liberal governments had repudiated, and (3) the relative abundance of capital in the European core economies during the 1880s which sought foreign outlets, that might explain the willingness to hold Portuguese debt just before the default.

⁸ Data from Mata (1993). The *conto* was a unit of account worth one million *réis*.

static measures of fiscal imbalance and the inherently dynamic models used in fiscal theory. Whereas traditional measures of budget imbalance indicate, at best, the short-term impact of fiscal policy, rational optimising agents should react to the impact of fiscal policy upon their lifetime tax burden, and not to its short-term effects. Furthermore, traditional measures of budget deficits or debt accumulation are contingent on arbitrary legal classifications of public receipts and payments, which may not coincide with their economic significance.⁹ The starting point of GA is the inter-temporal (long-term) budget constraint:

$$\sum_{v=t-M}^t A_{t,v} + \sum_{v=t+1}^{\infty} A_{t,v} = \sum_{s=t}^{\infty} G_s (1+r)^{s-t} - W_t^g \quad (1)$$

According to this expression, at each time t , the present value (discounted at rate r) of future government purchases of goods and services (G) should add up to the sum of three items: net government wealth (W^g) and the present value of the prospective aggregative net tax payments by generations already living at t and by those generations to be born after t .¹⁰ Auerbach *et al.* (1991) defined ‘generational accounts’ (A) as these present values of net tax payments over the remaining lifetime of the members of each generation. The generational account of generation v at time t is therefore given by:

$$A_{t,v} = \sum_{s=\max(v,t)}^{v+M} \tau_{s,v} N_{s,v} (1+r)^{-(s-t)} \quad (2)$$

where $\tau_{t,v}$ and $N_{t,v}$ stand for, respectively, the *per capita* tax payment (net of transfers received) that the individuals of generation v owe the government in year t , and the surviving members of generation v at time t .¹¹

These expressions also highlight other ‘meaningful’ characteristics of GA, when confronted with conventional measures of fiscal imbalance. First, GA includes the *stock* of public wealth in its calculations, which the greater number of conventional measures of budget *deficits* still do not,

⁹ For instance, it is equivalent (from an economic point of view) to increase the public debt in a year and repay the principal with interest in the next year, or to raise the same amount in taxes in the first year and make a transfer payment in the second year equal to the principal plus interest. However, the budget deficit will rise in the first case and decrease in the second.

¹⁰ The index v refers to ‘vintage’ or generation, so that the first item on the left-hand side of the budget constraint refers to the sum of the prospective net tax payments of the generations already living at t , that is, those born between $t - M$ and t , where M stands for the maximum age attained by the members of a given generation. The second item on the left-hand side therefore represents the prospective net payments of the generations still unborn at t .

¹¹ Notice that the index s starts at t for already living generations and v for future generations.

despite the evidence gathered by Eisner and Pieper (1984). Second, GA is a forward-looking concept that explicitly takes into account the prospective paths of government consumption, economic growth, inflation (as all flows are measured in real terms) and demography. The traditional measures either of budget deficit or debt accumulation are hardly, if ever, adjusted for these future conditions. Lastly, as the very name indicates, GA gives a measure of the inter-generational consequences of fiscal policy, inasmuch as any changes in the path of future government expenditure or in the future tax system reflect upon the generational accounts of living and future generations. In particular, any change in the stance of fiscal policy that eases the tax burden falling upon existing generations during their remaining life-span, will necessarily have to be compensated in the future by a greater burden placed on future generations. Auerbach *et al.* (1991) therefore suggest using the difference between the generational accounts (measured in *per capita* terms) of existing and future generations to measure fiscal sustainability, and as a criterion of inter-generational equity. The accounts of future generations may have to be greater than those of present generations in order to accommodate a fiscal policy unsustainable in the long-run, given the existing tax burden and projected growth of public purchases. In other words, future generations may have to be sacrificed to a lower tax burden for existing generations, which might be arguable in terms of equity.¹²

To be sure, all the theoretical advantages of GA have to be balanced against the considerably demanding data requirements needed to carry out its calculation.¹³ Nonetheless, the *per capita* generational account at t of a given generation born at v $a_{v,t}$ is a monetary amount with a meaningful interpretation in the context of the life-cycle budget constraint of an individual agent, contrary to traditional measures of budget *deficits*.

3.2. Implementation – current age profiles

The actual calculation of generational accounts is divided into two major parts referring to different moments in time:

- As of t : the distribution of the existing government net receipts (taxes minus transfers) by the generations already living at t , and the estimation of government's net wealth;

¹² Hence, the imbalance between current and future generations' accounts gives a quantitative measure of the distance between current policy and the inter-temporal budget constraint. For further clarifications see Auerbach *et al.* (1991, 1994).

¹³ To the question of the empirical difficulties in implementing GA we shall return presently. For a thorough discussion of these and other theoretical and empirical problems raised by GA, see Buiter (1996) and Haveman (1994), together with the indirect answer by Auerbach *et al.* (1994).

- In the future: the projections of the net tax burden on existing generations (over their remaining lifetime) and on generations still to be born, together with the projection of the future path of government purchases.

In the context of a study going back to the middle of the nineteenth century the question of the availability of all this information naturally arises, and more pressingly than for contemporary GA studies. To overcome the data limitations we had to make some choices and impose some assumptions, which, however, we put to the test by means of a sensitivity analysis.¹⁴

We want to assess the inter-temporal sustainability of Portuguese public finances during the period considered, which is an inherently forward-looking question, albeit studied a century to 150 years after the fact. This makes this study an exercise in trying to look forward with the eyes of the past, which naturally raises the question of the ‘prospective’ nature of the information to be introduced in the calculations. Ideally, we should only consider projections or estimates made by contemporaries themselves, and not the ‘historical’ values verified after each base year of our period. To do otherwise would make the generational accounts useless for measuring the impact of fiscal policy *as perceived by contemporary economic agents* upon their behaviour.¹⁵ Unfortunately, we were unable to find documented projections of the variables relevant to GA made by contemporaries. We combined instead some broad estimates of a few parameters with a more detailed reconstruction of demographic tendencies.

Starting with the first part of the calculations (as of t), the GA studies on contemporary US or European data are based on official statistics of the age-distribution of taxes and transfers or, at least, of other variables from which the age-profile of the net tax burden may be gauged.¹⁶ In our period of study such statistics are simply not available, so that we had first to estimate the age-distribution of the several components of the net tax burden. Beyond that, as we intend to build up a series of generational accounts for the period 1854–1910 (instead of for a single base year), this preliminary work had to be multiplied accordingly.

A prior step was to form estimates of the age profile of the population for each of the 57 years being studied and of the surviving members of each cohort born between 1854 and 1910. Again, the use of contemporary estimates of this age profile would be preferable but we could not find them in

¹⁴ More on this in Section 4.2.

¹⁵ Except, of course, if we assume perfect foresight.

¹⁶ Such as the age profile of consumption or of wage earnings. For examples of the use of this kind of source see Auerbach *et al.* (1991) for the US, taking 1989 as base year; Gokhale *et al.* (1997) also for the US but referring to 1995; Levy and Dore (1998) for France in 1995 and Auerbach *et al.* (1997) for Portugal, also in 1995.

any source of the period. To our knowledge, the first long-term projections of demographic tendencies made in Portugal are those quoted in Barbosa (1949), which cannot obviously be used for the period ending in 1910. Instead of making projections, contemporary writers (such as Freitas 1867, Figueiredo 1873 or Pery 1878) tried to reconstruct retrospective vital statistics for years before or between censuses. Hence, we made our own estimates of the annual cohorts based on official data gathered from the 13 censuses of population carried out in Portugal from 1864 to 1991, together with some other official estimates of the age profile of the population for years between censuses, covering the period 1941–1998.¹⁷ Details of the estimation procedure and of the sources employed are to be found in Appendix I.

The data on net tax payments (the $\tau_{t,v,s}$) were obtained from the series of Mata (1993), deflated by the wholesale price index of Justino (1991). The total net tax burden in each year was calculated as total government receipts minus the sales of assets from the public domain (*bens nacionais*), formerly expropriated from the church, charities or local government bodies, and the income from physical assets and public enterprises. The exclusion of these two latter items has to do with the measurement of W_t^g . As a matter of fact, all GA studies try to eschew the problem of evaluating the government's stock of tangible assets by resorting to the standard actuarial result that, in equilibrium, the value of an asset should be given by the present value of its service flows. If we omit the present and projected flow of income from these assets we can simply reduce W_t^g to the net financial wealth of the government (the inverse of the public debt).¹⁸

As for the distribution of the tax burden among the living generations, we used four different criteria, based on the estimated age profiles of consumption expenditures, property, wage income and, residually, of the population itself. The profile of consumption expenditures was derived by combining the results of an 'inquiry into the living conditions of the Portuguese working classes', dating from 1916, with a hypothetical dietary

¹⁷ It should be noted that, because generational accounts are lifetime accounts, we had to gather the data on the surviving members of each generation (the $N_{t,v,s}$) up to the time of its probable extinction. Based on the age profiles published in the censuses, we chose to distribute the population within our sample period in 106 cohorts (from those aged less than a year to 105 years) and to assume a maximum lifetime (M) of 125 years for the cohorts born during the same time period. This meant collecting demographic information for the period 1854–2035.

¹⁸ In fact, all acquisitions/sales of tangible assets would leave unchanged the impact of the fiscal stance between generations. In the case of a purchase of a tangible asset, the increase in W_t^g would cancel out the similar rise in G_t , whereas an expropriation would add to W_t^g the same amount that it would deduct from the stock of private wealth, so that, despite facing smaller lifetime tax burdens, individuals from future generations would also inherit a smaller stock of wealth. Finally, for converse reasons all sales of parts of the public domain cancel out with a smaller future stream of G_t .

pattern, arranged by age classes.¹⁹ This profile of consumption expenditures was used to distribute among the generations the sums of excise taxes (*real d'água* and *direitos de consumo*) and of import duties on consumption goods.²⁰ During the period 1862–1910, these items represented an average of 31.7 per cent of all public receipts spread among generations.

For the age profile of property we used the data on the ownership of government funded debt which was published by the *Junta do Crédito Público* throughout our period of study. To be sure, this information is, at best, a proxy for the distribution of personal property. Nonetheless, we retained these data for the distribution of taxes on property (both personal and real) because there is no alternative source for the distribution of real property or a source for private property as comprehensive as the data on the funded debt. In fact, we can be a bit more confident about the usefulness of our data source, because a substantial share of funded debt had been issued in exchange for the compulsory sale of landed property owned by the church, local government bodies and charities, as determined by laws issued between 1861 and 1866. In this sense the data on the ownership of funded debt might be partially representative of the distribution of real property up to these dates. According to the reports of the *Junta do Crédito Público*, the amount of debt issued for this purpose, between fiscal years 1860–61 and 1886–87, amounted to 12,447 *contos* or 6.1 per cent of the total internally funded debt floated in that same period. Furthermore, the majority of the taxes levied by this means did not actually fall on property but on income from property or enterprise, for which the age-profile of the ownership of funded debt might be an acceptable proxy. The items of revenue distributed according to the age-profile of property included corporation income taxes (class A of the *contribuição industrial*, the *contribuição de juros* and the annuities due from the several tobacco monopolies), the personal income tax (*imposto de rendimento*), property taxes (*sisá*, *contribuições pessoal*, *sumptuária* and *de rendas de casa*), inheritance taxes (*imposto de transmissão de propriedade* and *contribuição de registo*), import duties on capital and intermediary goods and the old *décima*. The average weight of these items of revenue was 46.8 per cent (1862–1910).

Our estimate of the age-profile of wage income was used to distribute among living generations the revenue from class B of the *contribuição industrial*, which on average accounted for 2.4 per cent of total public receipts, between its creation and 1910.²¹ In order to form this profile we had to

¹⁹ Even though 1916 is already out of our sample period, this is the first survey of Portuguese consumption habits that may be considered representative. Appendix 2 describes the details of the application of this profile of consumption expenses, as well as of the wage income and property profiles.

²⁰ The allocation of import duties between consumption and production goods was based on the average *ad valorem* levels of Lains (1987, p. 490).

²¹ Despite the mixed nature of the *décima industrial*, we were unable to distinguish between

gather two sources of information. On the one hand, we used data on the age structure of wages, as gathered from three inquiries made during our time period (in 1865, 1881 and 1909–10); on the other, the age profile of the working population, established from these three inquiries and the censuses of 1890, 1900 and 1911. Lastly, the items of revenue for which no specific age structure could be attributed were residually spread according to the age profile of the total population. This revenue (averaging 19 per cent of total receipts) included stamp and other duties, together with other minor taxes, indistinguishable from official sources. Still another class of flows distributed by age was that of transfers, which during our period corresponded to the so-called *classes inactivas*, that is, payments made to retired public servants and military personnel and the compensations due to the former monks and friars of the religious orders extinguished in 1834. The age distribution of these transfers was limited to cohorts aged 60 years or more, in accordance with the contemporary laws regulating retirement.

Turning to the right-hand side of expression (1), the yearly levels of public consumption (G_s) were calculated from the series of public expenditures of Mata (1993) with the sole adjustment being to exclude the value of transfers, which, as we have just mentioned, were subtracted from the $\tau_{t,v}$ s. Government's net financial wealth cannot be measured by the inverse of total debt outstanding in each year, because Portuguese debt was always floated below par. This meant that the annual accumulation of nominal debt exceeded the budget deficit, whereas expression (1) assumes that the two values are equivalent.²² To correct for this difference we quantify W_t^g as the accumulated real net receipts from borrowing, as estimated in Esteves (2002).²³

3.3. Implementation – projections into the future

Beyond the demographic tendencies already mentioned, GA studies require that we project into the future the evolution of net tax burdens and government consumption. For the reasons stated in the previous section, we chose

the revenue from corporations and from workers, because the official sources only published the aggregate *décima* revenues. The distinction was only possible from 1862, when the data on the *contribuição industrial* started to discriminate between class A (corporations) and class B (payroll).

²² To be more precise, expression (1) can be derived by forward iteration of the dynamic budget constraint $D_t - D_{t-1} = rD_{t-1} + G_t - T_t$. However, if debt is issued under par, we now have $D_t - D_{t-1} = (1/p)(rD_{t-1} + G_t - T_t)$ or $pD_t - pD_{t-1} = rD_{t-1} + G_t - T_t$, where p is the price of debt as a percentage of par. This last expression means that we have to use accumulated net receipts from borrowing instead of total debt outstanding as a measure of government net wealth.

²³ Actually, we only have information on real net receipts from borrowing from fiscal year 1850–51 onwards. The accumulated measure was built assuming that $p = 50$ per cent for all debt issued prior to that date.

to ignore the historical paths of tax burdens and government consumption to preserve the forward-looking nature of our estimated accounts. As an alternative, the future path of net tax burdens falling both on existing generations (for their remaining lifetime) and on future generations was projected according to the standard assumption in GA studies that ‘each successive generation’s payment is the same up to an adjustment for real productivity growth’ (Auerbach *et al.* 1991, p. 61). If we let y stand for real productivity growth, this assumption translates into $\tau_{s,v} = \tau_{t,v} (1 + y)^{s-t}$, $s > t$ for each generation already living in t , that is, $v = t - M, \dots, t$. As for future generations we assume that $a_{t,v} = a_{t,t+1} (1 + y)^{v-t-1}$, $v > t$, where $a_{t,v}$ is the *per capita* account of the generation born at v , discounted all the way back to t .²⁴ In plain words, the members of future generations are assumed to pay, on average, the same as those of the first generation born after t ($a_{t,t+1}$) except for the productivity adjustment.²⁵ For the period covered by our study there are no available estimates of the aggregate rhythm of productivity growth.²⁶ Hence, we used the average growth rate of the real product index of Lains (1994), discounted by the growth of population, which amounts to 0.7 per cent.

The future path of government consumption was introduced supposing that it would grow at a constant rate of 2.6 per cent *per annum*, which corresponds to the average real growth rate of G_s between 1854 and 1910. The last parameter we need to introduce in order to calculate the generational accounts is the discount rate. As we are dealing with the government’s budget constraint, the natural choice would seem to be the real interest rate on public debt.²⁷ However, generational accounts are to be interpreted from the individual’s standpoint, not from the government’s. Because individuals may be risk averse, their expected fiscal burden should not be discounted at the rate at which the government will have to service its debt, but at a higher discount rate that accounts for the risk the individuals might attach to their future tax obligations. As for the limits of this discount rate, Auerbach *et al.* (1994, p. 78), are of the opinion that

Future government receipts and expenditures are risky, which suggest that they be discounted by a rate higher than the real rate of interest on government securities. On the other hand, government receipts and expenditures appear to be less volatile than the real return on capital, which suggests that they be discounted by a lower rate than that.

²⁴ That is: $a_{t,v} = A_{t,v}/N_{v,v}$, $v > t+1$.

²⁵ This assumption regarding the spread of the fiscal burden over future generations is clearly only one among many possibilities. We could, for example, assume some kind of phase-in of future tax burdens that alleviated the burden on earlier future generations at a greater cost to later ones.

²⁶ We only have the separate estimates of productivity growth in agriculture (0.42 per cent on average between 1850 and 1910) and industry (0.65 per cent) from Lains (1990).

²⁷ Because of the interpretation of expression (1) as the solution by forward iteration of the government’s dynamic budget constraint.

In accordance with this line of reasoning we selected a 7 per cent discount rate, which is higher than the 5.4 per cent real average yield of internal consolidated debt during our period (data from Esteves 2002) and lower than what might be expected as a return on capital.²⁸ We gauged the upper bound on r from the answers given by businessmen to the industrial inquiries of 1865 and 1881. One of the topics of both inquiries had to do with the availability of capital to borrow. As the minimum interest rate at which the respondents stated they could borrow money was 7 per cent we took it that the normal return on capital should exceed this rate.²⁹

After establishing estimates for the two items on the right-hand side of (I), according to the aforementioned assumptions, and having distributed the net fiscal burden across living generations, the accounts for future generations can be determined residually. Then, applying the assumption that these grow (in *per capita* terms) at rate y , we can solve expression (I) for $a_{t,t+1}$. In order to assess the fiscal trade-off between generations we compare this *per capita* account with that of the sole living generation comparable, that is, that of the generation just born at t , $a_{t,t}$.³⁰ The quotient $a_{t,t+1}/a_{t,t}$ will then be employed to measure the inter-temporal sustainability of the government financial position.

4. Findings

4.1. Generational imbalance, 1854–1910

Tables 2 and 3 summarise the present value of lifetime net tax burdens falling on decennial cohorts in 1854 and 1910, respectively. They also detail the components of these tax burdens by the four criteria used to distribute fiscal revenue across living generations.

As can be seen, newborns in 1854 were expected to pay a net tax burden over their entire lifetime having a current value of 15,891 réis.³¹ Likewise,

²⁸ It is true that 5.4 per cent was not a risk-free rate, as compared, for example, with the average return on British consols of 2.98 per cent between 1850 and 1909 (Homer and Sylla 1996, pp. 196–7, 444). However, Portuguese taxpayers (bondholders and non-bondholders) had to face additional uncertainty about their future tax liabilities. In this sense, a financial crisis would most likely be met by an increase in taxes or by the monetisation of the deficit, which would put an extra cost on taxpayers, arguably not captured by the market risk premium.

²⁹ Otherwise the borrowers could not finance their activity with borrowed capital. Also notice that 7 per cent is only slightly higher than the 6 per cent discount rate Auerbach *et al.* have been using in their studies for the US. Auerbach *et al.* (1997) used 5 per cent for Portugal.

³⁰ Recall that all other living generations have already exhausted part of their maximum possible lifetime, so that they cannot be compared with future generations that still have their lifetime ahead of them.

³¹ At par, this was equivalent to almost £3 10s. 8d.

Table 2. *GAs for Portugal, 1854 (base case).*

Age	Per capita account	Consumption	Property	Wages	Age	Transfers
0	15,892	5,934	3,825	0	6,133	0
10	29,807	16,783	5,002	0	8,022	0
20	28,322	16,923	4,378	0	7,021	0
30	34,580	16,194	11,667	0	6,719	0
40	40,627	14,838	19,633	0	6,156	0
50	45,929	13,748	26,477	0	5,704	0
60	2,408	10,063	27,824	0	4,566	-40,045
70	8,493	9,455	32,374	0	4,290	-37,626
80	10,002	6,423	26,226	0	2,914	-25,561
90	12,150	5,482	25,996	0	2,487	-21,815
100	6,993	2,432	13,136	0	1,104	-9,679
105	3,752	1,171	6,708	0	531	-4,658
Fut. Gen.	125,512	Differential	+689.8%			

Notes: All values in réis at constant prices of 1863–67.

Source: Author's calculations.

Table 3. *GAs for Portugal, 1910 (base case).*

Age	Per capita account	Consumption	Property	Wages	Age	Transfers
0	98,189	17,280	30,077	0	50,832	0
10	101,834	31,705	25,670	1,074	43,385	0
20	116,153	38,811	27,146	4,319	45,878	0
30	124,151	34,396	45,270	3,828	40,659	0
40	139,488	31,778	66,610	3,536	37,564	0
50	137,117	26,285	75,598	4,163	31,071	0
60	90,720	18,220	72,839	3,155	23,550	-27,044
70	80,276	14,186	68,810	0	18,336	-21,056
80	72,840	11,186	63,799	0	14,459	-16,604
90	62,492	8,486	55,633	0	10,968	-12,595
100	40,095	4,880	36,152	0	6,307	-7,243
105	19,156	2,216	17,365	0	2,865	-3,290
Fut. Gen.	492,785	Differential	+401.8%			

Notes: All values in réis at constant prices of 1863–67.

Source: Author's calculations.

individuals aged ten would pay 29,806 réis, and so on. One can detect a life-cycle pattern in these accounts, which rise from childhood up to the fifties, and decline thereafter. This profile agrees with the intuition that the current-value net tax burden should rise during active life and subside with

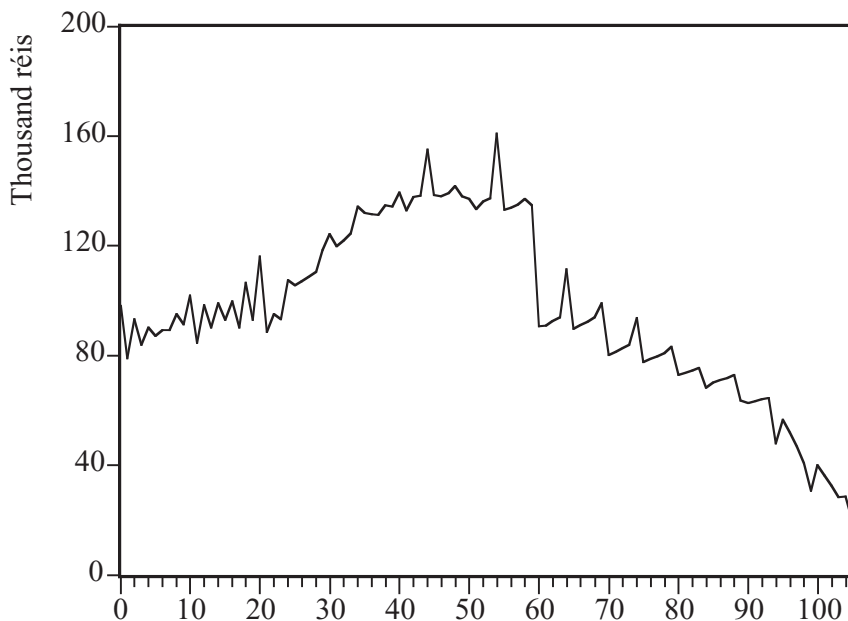


Figure 1. *Generational profile of lifetime net tax burdens in 1910.*

Source: Author's calculations.

old age and retirement.³² Figure 1 illustrates this life-cycle pattern of net tax burdens for the year 1910.

When we calculate our measure of inter-temporal sustainability, we find that, as of 1854, the average lifetime burden falling on future generations (125,512 réis) was something like 690 per cent greater than the newborns' generational account. In other words, if the current expected path of government consumption and of tax burdens on living generations were to be maintained after 1854, future generations would have to sustain a lifetime net burden almost eight times as great as that of current ones just to restore the government's inter-temporal budget equilibrium. Hence, it would seem that Portuguese fiscal policy was unsustainable to a massive degree even before the actual start of the programme of *melhoramentos materiais*. This was only to be expected, in the face of the extremely difficult management of public finances prior to the 1850s mentioned in Section 2 above.

Turning to the other end of our period, the year 1910, despite a notorious improvement Portuguese finances still remained unsustainable in inter-temporal terms, with a generational account of future generations slightly above five times that of current newborns.

³² However a highly regressive tax structure (mainly dependent on indirect taxes), coupled with the very limited degree of social protection afforded by the Portuguese state during this period, dictated positive net payments up to the time of death, contrary to present-day GAs, which become negative even before retirement age.

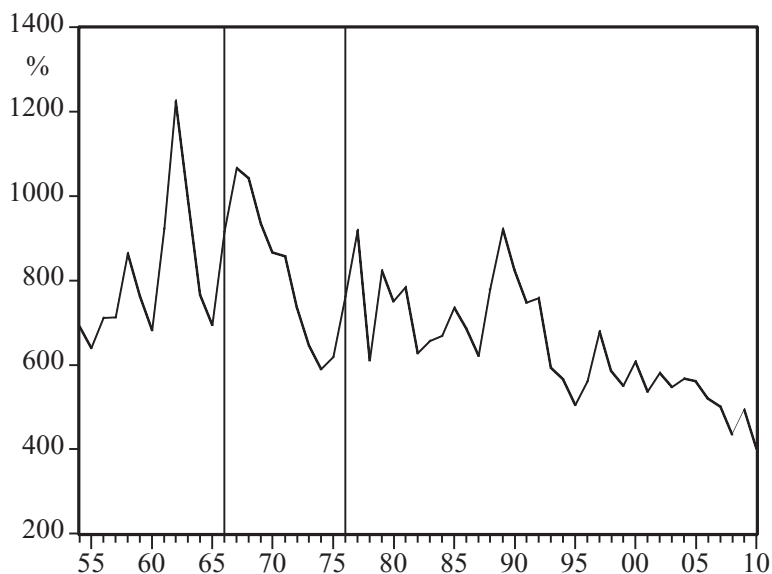


Figure 2. Generational imbalances ($a_{t,t+1}/a_{t,t}$), 1854–1910.

Source: Author’s calculations.

After repeating this exercise for all 57 years between 1854 and 1910 we built a continuous series of generational imbalances ($a_{t,t+1}/a_{t,t}$), which is represented in Figure 2. Figure 3, which depicts the real budget deficit serves as a benchmark.

Globally, the evolution of the series in Figure 2 tracks the path of the budget imbalance, which is not surprising if we remember that any annual deficit adds to item $-W_t^g$ on the right-hand side of expression (1) and that we assumed a constant rate of growth for the individual future net tax burdens falling both on living and still unborn generations. The three major financial crises during this period, 1866, 1876 and 1890–92 (stressed in both Figures) are also associated with a worsening both of the generational and of the budget imbalances, albeit with a lead in the first two cases and a lag in the last one. However, when we compare levels instead of slopes, the two series exhibit some remarkable differences. First, the highest generational imbalances (with the exception of the early 1890s) are concentrated prior to 1880, whereas budget deficits are particularly high throughout the 1880s. The coincidence of soaring generational imbalances with moderate deficits in the first part of our period has to do with the growth of the net tax burden throughout our period.³³ A second distinctive aspect is the structural break associated with the 1892 partial default and subsequent return to a pattern

³³ That is to say: smaller deficits in the 1860s would prop up higher generational imbalances because of the small tax burden levied on living generations. In the later decades greater deficits were partially compensated by a more buoyant tax policy.

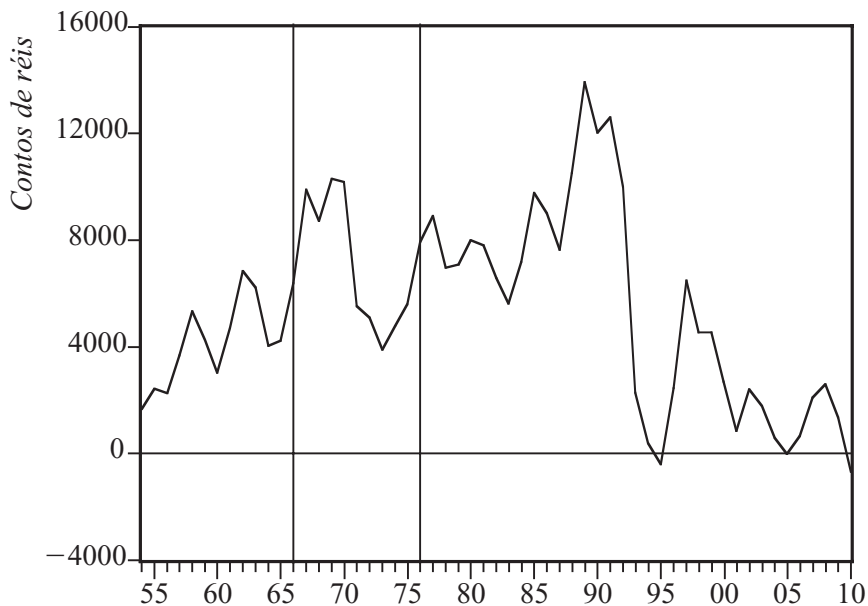


Figure 3. *Real budget deficit, 1854–1910.*

Notes: All values in *contos* at constant prices of 1863–67.

Sources: Nominal deficit from Mata (1993), deflated with the price index of Justino (1991).

of ‘sound finances’. Despite the reduction in the average deficit from 7,065 *contos* (1860–89) to 3,688 (1890–1910), the differential between the accounts of future and living generations remains massive until the end of the period. The absolute minimum, reached in 1910, still amounted to something more than 400 per cent. Hence, the draconian measures of the early 1890s either were not enough or were not systematically carried through once the worst difficulties had been accommodated. This persistence of generational imbalances notwithstanding, the improvements in current fiscal policy are a natural consequence of the level of long-term indebtedness inherited from the ‘*melhoramentos materiais*’, which correction would require a more or less protracted succession of primary surpluses.³⁴ We can get a greater insight into the necessary correction measures with the help of some counterfactual experiments. In fact, one of the advantages of generational accounting is that we can easily determine the value of the adjustments in the tax burden and/or in the path of public consumption so

³⁴ Our assumption of a constant growth rate of public consumption might also be partially responsible for the high levels of generational imbalance after 1890. However, even if we replaced g after 1889 with 1.62 per cent (the average real growth rate of public consumption after 1889) we still end up with a minimum generational imbalance of 291 per cent in 1910.

as to restore generational equilibrium. For instance, if we take the year 1892, the differential between that year's accounts of future and living generations amounts to something like 758 per cent. This is the percentage increase in the lifetime net tax burden on living generations required to restore inter-temporal sustainability of public finances. However, this could otherwise be corrected by cutting the current value of public consumption by 82.4 per cent (with $g = 2.6$ per cent thereafter) or 72 per cent, assuming that the flow of real public consumption would remain constant after 1892. Naturally, the burden of adjustment could be distributed between lifetime net tax burdens and public consumption. Again taking the case of 1892, generational balance could be regained by combining, for example, a 50 per cent increase in generational accounts with a 54.7 per cent decrease in current public consumption.³⁵ As it happens, according to our calculations the fiscal measures taken in 1892 only added 2.1 per cent to the sum of accounts of living generations (and only 0.8 per cent to those of new-borns) and deducted 0.3 per cent from the flow of public consumption. This kind of exercise can be repeated for all years in our sample with the same qualitative result, namely a huge inter-temporal differential, which could only be balanced through massive cuts in public expenditure or increases in taxation or both.

To conclude the base case findings, we should add a note on the allocation of specific public expenditures to their immediate beneficiaries. In principle, all expenditures whose age pattern may be identified should be treated as transfer payments, instead of as government consumption. A class of spending usually treated in GA studies as transfer payments is that on education. However, we only have information to disaggregate the global spending in education into its primary, secondary and university levels from fiscal year 1883–84 on. Furthermore, our knowledge of school enrolments prior to the 1880s, at levels other than university, is also rather scant. Hence we could not distribute spending on education by age groups. Nonetheless, the netting out of these expenditures from the path of government consumption and their distribution by generations would lead to greater generational imbalances, provided that, as in our case, $g > y$.³⁶

4.2. Sensitivity analysis

A standard procedure in GA studies as regards the choice of parameters is to test the sensitivity of the results to the values of these parameters. As we

³⁵ We assumed that g was equal to 2.15 per cent, the average annual growth of G between 1892 and 1910. Had we used $g = 0$ instead, the reduction in public consumption would only have to be 34.5 per cent.

³⁶ Furthermore, expenditures on education held a marginal weight in the total government outlay during our period of study. According to Mata (1993) they averaged no more than 3.1 per cent of total expenditure between fiscal years 1853–54 and 1910–11.

Table 4. *Sensitivity analysis: average deviations from base case (%)*.

		r = 5%	r = 6%	r = 7%	r = 8%	r = 9%
y = 0.5%	g = 1.8571	-31.92	-23.48	-12.35	0.79	15.63
	g = 2.2286	-18.55	-12.63	-2.84	9.47	23.75
	g = 2.6	-1.05	0.58	8.27	19.35	32.82
	g = 2.9714	22.86	17.04	21.43	30.68	43.00
	g = 3.3429	57.49	38.10	37.26	43.82	54.52
y = 0.6%	g = 1.8571	-35.70	-27.09	-15.92	-2.79	12.00
	g = 2.2286	-22.87	-16.62	-6.69	5.66	19.93
	g = 2.6	-6.07	-3.85	4.09	15.28	28.79
	g = 2.9714	16.88	12.05	16.87	26.32	38.73
	g = 3.3429	50.11	32.39	32.23	39.12	49.99
y = 0.7%	g = 1.8571	-10.96	-8.18	-19.41	11.29	11.17
	g = 2.2286	-27.07	-20.51	-10.46	1.92	3.36
	g = 2.6	-10.96	-8.18	-	11.29	11.17
	g = 2.9714	11.04	7.16	12.39	22.04	19.94
	g = 3.3429	42.91	26.80	27.30	34.51	29.86
y = 0.8%	g = 1.8571	-42.94	-34.07	-22.84	-9.78	4.88
	g = 2.2286	-31.16	-24.31	-14.16	-1.76	12.45
	g = 2.6	-15.73	-24.31	-4.02	7.36	20.90
	g = 2.9714	5.36	2.39	8.00	17.83	30.39
	g = 3.3429	35.89	21.34	22.46	29.97	41.13
y = 0.9%	g = 1.8571	-46.41	-37.44	-26.20	-13.19	1.41
	g = 2.2286	-35.13	-28.03	-17.79	-5.38	8.80
	g = 2.6	-20.36	-16.56	-7.95	3.50	17.05
	g = 2.9714	-0.17	-2.28	3.70	13.69	26.32
	g = 3.3429	29.06	15.99	17.72	25.50	36.80

Notes: The base case is defined by $y = 0.7%$, $r = 7%$ and $g = 2.6%$.

Source: Author's calculations.

eschewed demographic projections, our findings are dependent on three critical parameters: y , r and g . Table 4 summarises the average sensitivity of the generational differentials in our sample period to four alternative values (two smaller and two greater) for each of these three parameters.³⁷

The alternative values were chosen so as to differ by the same percentage from the base values.³⁸ *Ceteris paribus*, it can be shown that an increase in y or a decrease in g will always lead to a decrease in the differential between

³⁷ For brevity, we only present average deviations from the base case of the generational imbalances throughout our 57-year period of analysis. However, in the majority of cases, the annual individual deviations are not significantly different from the average deviation reported in Table 4.

³⁸ That is, one (one tenth of a) percentage point is about 14.3 per cent of 7 per cent (0.7 per cent), and 2.6–2.2286 per cent is something like 14.3 per cent of 2.6 per cent.

generational accounts. The sign of the effect of an isolated change in r is ambiguous because a rise in the rate of discount produces two countervailing effects: a smaller present value of public consumption and a smaller sum of living generations' accounts. The former effect tends to lessen the differential and the latter raises it. With our figures, though, higher values of r are associated with greater average generational imbalances and *vice versa*. When we mix the effects of the changes on the three parameters these same signs are maintained in the majority of cases.

As regards the absolute values of the average deviations, although some of them are very significant, they do not challenge the qualitative result of a massive generational imbalance throughout our period. Even in the most benign scenario ($y = 0.9$ per cent, $r = 5$ per cent, $g = 1.8571$ per cent) the range of differentials would run from 184.6 per cent to 696.1 per cent, against the 401.8 per cent – 1,224.9 per cent range of the base case.³⁹

Such a situation certainly could not carry on for so long in any contemporary economy.⁴⁰ However, we should place our results in a proper perspective, so as to avoid unwarranted comparisons with GA studies on present-day economies, like the one we were just suggesting. A material difference that distinguishes the nineteenth century from the late twentieth century is the economic burden of government. Two small indicators serve to illustrate this fact. According to data from Nunes *et al.* (1989), budget deficits averaged a mere 1 per cent of GNP during our period, whereas total public revenue grew from 4.5 per cent of GNP (1854) to 7.1 per cent in 1910. Among small European countries, the burden of government in Portugal in 1910 seemed to be halfway between low spenders such as Denmark, the Netherlands and Spain and high spenders, such as Belgium and Italy.⁴¹ Even if we discount for the fact that the present levels of current government expenditure were inconceivable a century ago, governments then arguably had a much wider margin to correct for their generational imbalance, as compared with their current successors. Furthermore, the demographics of the period also eased the government's inter-temporal

³⁹ As regards the magnitude of the deviations from the base case they are in line with the results from other GA studies. For instance, in the study for Portugal by Auerbach *et al.* (1997), a change of two percentage points in r leads to deviations between –35.95 per cent and +71.87 per cent from the base case. In the same study, half a percentage point change in y produces deviations between –12.11 per cent and +14.37 per cent of the base case.

⁴⁰ For instance, a more recent revision of US generational accounts estimated a generational imbalance of 71.9 per cent for both sexes in 1995 (Gokhale *et al.* 1997), whereas Auerbach *et al.* (1997) calculated imbalances of 105.7 per cent for males and 77 per cent for females for the same year in Portugal.

⁴¹ In this year government receipts represented 4.7 per cent of GNP in Denmark, 4.9 per cent in the Netherlands and 5 per cent in Spain, against 9.6 per cent in Belgium and 10.9 per cent in Italy. Sources: Mitchell (1998) for public revenue and Maddison (1991 and 1995) for GNP.

budget constraint. Between 1854 and 1910 population grew at an average rate of 0.7 per cent, and although the dependency ratio almost doubled, it remained at a modest 6.17 per cent in 1910.⁴² This might explain why the generational imbalance was allowed to run for so long before making the government's budget constraint binding, during the 1890–93 financial crisis.

5. Final comments

The evidence obtained from the generational accounts broadly sustains the view that Portuguese finances, despite the high hopes of the *melhoramentos materiais*, were running on an unsustainable path that would eventually lead them to the 1892 nadir. However, contrary to conventional measures of budget deficits and debt increase, GA evidence allowed us to quantify this broad intuition into a meaningful economic measure of inter-temporal sustainability. The excesses of long-term indebtedness were let run for so long that all corrective measures taken after the 1892 default were not enough to change the situation substantially. On the eve of the republican regime in Portugal, the imbalance between generations' net fiscal burdens, albeit smaller, remained overpowering.

Despite the massive imbalance of inter-generational accounts, its impact, both for the economy and for the government's accounts, was probably not so significant as might otherwise be expected because of the relatively small burden of government in the economy. In the words of one of the most influential Portuguese politicians at the turn of the century, 'This explains, to a large extent, the fact, the undeniable truth, that the treasury is poor but the country is not' (Ribeiro 1898, p. 244-B).

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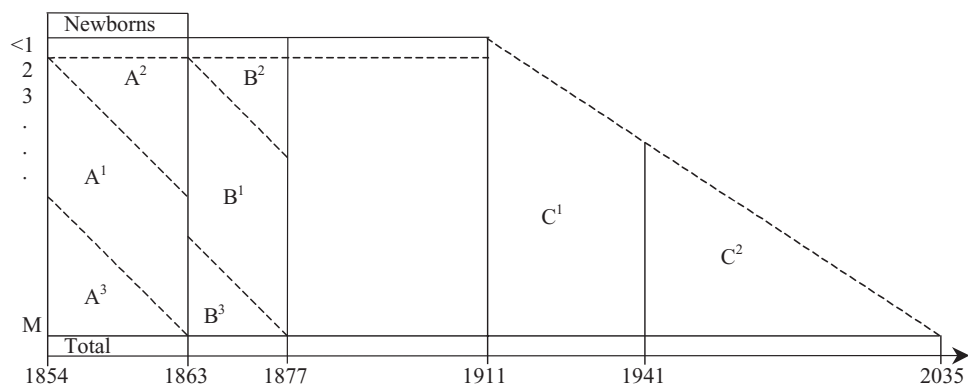
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Appendix 1

As mentioned in the text, the 13 general censuses of population, held between 1864 and 1991, are the most comprehensive source of demographic information for our study. The first census to disaggregate the population into annual cohorts was that of 1940, whereas for the earlier years we only have the first annual cohorts, with the older ones aggregated into five-year classes. Nonetheless, whenever possible, we used the previous census information to break up these five-year age classes into their annual component cohorts. The process of inter- and extrapolation is summarised in the Appendix Figure.

Starting with the years between censuses, during our time period, areas B¹ through B³ represent the estimated annual cohorts between the reference years of the first two Portuguese censuses (1863 and 1877). The cohorts in area B¹ were linearly interpolated from the corresponding cohorts in the limit years. ‘Corresponding’ here means the pairs of cohorts that differ by the same number of years that separate the reference years. For instance, the cohort of less than a year



Appendix Figure. *Interpolations and extrapolations of annual population cohorts.*

in 1863 was used together with that of 14 years in 1877 to interpolate the cohorts of ages 1 to 13 from 1864 through to 1876, respectively. A similar interpolation was used in area B³ with the sole difference that we assumed all generations to be extinguished in the year where its members reached the maximum age (M) of 105 years. The cohorts in area B² were estimated recursively. That is, after interpolating all cohorts in areas B¹ and B³, the sole cohort left in year 1864 is that of less than a year. As we have independent estimates (actually logarithmic interpolations between censuses until 1891) of total population during this period from Nunes *et al.* (1989) we simply deduced the sum of all cohorts interpolated from the estimate of total population in 1864 to get the number of individuals of less than a year in age. This being done, the estimate of this last cohort could be used to interpolate all cohorts of ages 1 to 12 between 1865 and 1872, in the same manner as in area B¹ and so forth, until all cohorts were estimated so that their totals added up to the numbers given by Nunes *et al.* (1989).

Areas C¹ and C² were treated basically in the same manner as area B¹ except for two adjustments. On the one hand, as these areas are located after our period of analysis we only had to interpolate the number of surviving members of the generations present between 1854 and 1910, so we did not need to reconcile the cohorts with the estimates of total population as in area B². On the other hand, starting in 1941 we have access to official estimates of the age profile of population between censuses, distributed in five-year classes. This data can be found in Conim (1977) for the period 1941 to 1975 and in the *Anuário Estatístico* of the INE and in the OECD Statistical Compendium for later years. For this reason the interpolations in area C² were made subject to the aggregate information on five-year classes.

Finally, we had to extrapolate backwards the cohorts in areas A, because there is no information on the age profile of population prior to 1863. For this purpose we used a contemporary estimate of the age profile of mortality reported in Cascão (1993) that, together with the age distribution of population in 1863, served to calculate the mortality rates for age groups used to extrapolate backwards the dimension of annual cohorts until 1854. For the first cohort (less than a year) we firstly estimated a series of newborns and then applied to it the child mortality rate of 147.16 per thousand as derived from Cascão (1993).

Appendix 2

Consumption expenditures

The basis of our estimation of an age profile of consumption expenditures came from the 'inquiry into the living conditions of the Portuguese working classes' carried out between 1916 and 1917 and published in numbers 2, 3 and 4 of the *Boletim de Previdência Social*. The rationale for this inquiry stemmed from the price upsurge associated with World War I and which the Portuguese government was concerned to control by setting up a regular consumer price index. The results published involved 2,403 individuals forming 538 families from the 'working classes' chosen according to location, dimension and family income. We aggregated the data on family expenditure into three main categories, namely, food, education and other (rents, fuel, transportation, mutual insurances, amusements, and so on). Foodstuffs absorbed 73.2 per cent of total expenditure, education 0.8 per cent and

the remainder went on other expenditures. The age distribution of these three items was made according to different age profiles. Education expenses were allocated to the annual cohorts between ages 7 and 15 (roughly equivalent to primary and secondary schooling). For food we resorted to an age profile of dietary needs reported in Faria (1942, p. 14), which defined coefficients of food needs for several age classes with respect to the pattern given by the 'male adult' (14 through to 59 years of age). We then combined these coefficients with our estimates of annual population cohorts to get a year-by-year distribution of food consumption. Although theoretical, this dietary pattern agrees with some other contemporary information on the relative distribution of food consumption by age groups. For instance, Martel (1911) referred to the fact that, in 1910, children (that is, those up to 10 years) demanded half the average food expenditure of adults. According to our data for this year, the average expenditure of cohorts up to 10 years of age was 50.7 per cent of that of the individuals in cohorts from 14 to 59 years. Finally, the category of 'other expenditures' was distributed by age according to indirect indications of the age of the members of the families surveyed. The inquiry classified the 2,403 individuals surveyed into 'fathers', 'sons earning a wage', 'sons with no wage' and 'others'. We assumed that the category 'fathers' included individuals aged between 21 (legal majority) and 59; we split the two classes of sons at age 10; and we considered the residual class to be composed only of the elderly (60 years old or more), in accordance with the 'nuclear family' pattern of contemporary working class families.

Our estimate for the age profile of consumption expenditures was then obtained by adding the money amount distributed to each cohort according to the three items of expenditure surveyed in the 1916–17 inquiry.

Property ownership

Starting in 1860, the annual reports of the *Junta do Crédito Público*, the agency responsible for the management and service of the public debt, publicised the amounts and classes of owners of funded debt with *assentamento*, that is, nominative debt. Although the classification of the *Junta* only indirectly translates the ages of the owners we were able to derive from it a tentative age-profile of the ownership of nominal funded debt. This was made by grouping the several types of owners described in the reports of the *Junta* into four main categories: minors, adults, corporations and others. As in previous cases, the amounts headed 'others' were ascribed proportionally to the age-profiles for each year as estimated in Appendix 1. These included not only residual or obscure categories for which no specific age structure could be identified, but also the amounts of funded debt actually owned by public institutions (or equivalents such as the Crown) and that should be considered as the property of the entire nation. Beyond the sums explicitly classified in the reports as funded debt in the possession of 'minors' and 'adults', we also added to the latter the values originating in contracts or juridical institutes in which only those who were adults in the eyes of the law (that is, those at least 21 years old) could participate. For instance, this would include the debt owned by church bodies and the clergy, or money immobilised as caution for mortgages. We further added to the heading 'adults' the value of all bonds floated without registry of property, and whose owners were obviously not mentioned in the reports of the *Junta*

do Crédito Público. Finally, we subtracted the debt owned by private companies and corporations because they were themselves owned by individuals, so that if we included these values in our calculations we would be double counting.

As a final step we distributed the amounts within each of the three aggregate headings ('minors', 'adults' and 'other') by age in proportion to the age-profile of the population, for example, the debt owned by 'minors' was distributed to the cohorts up to 20 years of age and that in possession of 'adults' to the cohorts of 21 years or more.

Wage income

The first step in building an age profile of wage income was the estimation of the age structure of the active population. The 'industrial inquiries' of 1852, 1865 and 1881 classified the working population into minors and adults, whereas the more comprehensive censuses of 1890, 1900 and 1911 classified the economically active population into more detailed age classes. We connected the information from these two sources by assuming that 'economic majority' was reached at sixteen, and that the economically active population ranged from 10 to 69 years. Both the choice of the age of 10 to delimit the working age and of 16 to divide 'minors' from 'adults' were based on the usage of contemporary statistics. For intervening years between the inquiries we interpolated the age classes and, as usual, we disaggregated the classes into cohorts using the same proportions as the age-profile of the total population.

The data on wages are both scarcer and more aggregated than those on the active population. The only information we could gather came from the already mentioned 'industrial inquiries' of 1865 and 1881, together with a similar survey, dated from 1909–10 (reprinted in Cabral 1977) but that, contrary to the two surveys, was not administrated by enterprises but by trade unions. All three sources only distinguished between wages earned by minors and adults, which we also divided at the age of sixteen. Our estimate of the age profile of wage income was then obtained by multiplying the age profile of the active population by the wages it earned. A last word of clarification should be made regarding the nature of the wage income reported by the sources we used. Although it is true that the surveys we used exclusively dealt with industrial workers, this should not be considered as a limitation of our estimates of the wage profile, inasmuch as we are using them to distribute the amounts of the payroll tax, which, at the time, did not fall on the wages of agricultural workers.