The Forsaken Road: Reassessing Living Standards Following the Cuban Revolution and the American Embargo

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Abstract

We investigate the causal effects of the 1959 Cuban Revolution on income using a synthetic control approach. We employ a novel dataset with revised GDP estimates that do not rely on the regime's self-reported statistics. We also analyze GDP estimates net of aid coming from the Soviet Union. Our identification strategy allows us to separate the direct effects of the revolution from the diplomatic events that ensued. By overcoming concerns that Cuban GDP statistics are inflated either by the regime's direct manipulation or by Soviet aid, we identify a large decline in Cuban GDP per-capita relative to its counterfactual. The decline is larger when accounting for Soviet aid. The embargo only accounts for a minor share of Cuba's under-performance relative to the counterfactual. Our results hold after being subjected to multiple robustness checks and lead to the conclusion that the Revolution was the main driver of the inferior economic path Cuba has followed since 1959.

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1 Introduction

Fidel Castro's accession to power in Cuba in 1959 was a defining event of the 20th century. Once a relatively prosperous country within the Americas, it experienced growth sufficiently fast to converge with its few wealthier counterparts, Cuba saw a reversal of fortunes which is often timed at 1959.[1] Today, Cuba remains a relatively poor nation due to its slow economic growth after 1959, and many of its purported advantages – such as low infant mortality and high life expectancy – are debated as potential statistical artifacts (Gonzalez and Gilleskie, 2017; Berdine et al., 2018; Geloso et al., 2020). This makes Cuba a particularly compelling example of a reversal of fortune (Acemoglu et al., 2002, 2006; Coatsworth, 2008).[2] Understanding its causes is not only interesting for assessing Cuba's trajectory but also valuable for economists interested in development more broadly.

We say "1959" rather than "Fidel Castro" because the causal roots run deep and intertwine, forming a tangled web that has made it difficult to state anything with certainty. Indeed, the Cuban revolution is perhaps the most relevant question in Latin American political economy that still lacks a clear answer. We believe this gap arises from three main factors. First, there are the policies of the Castro regime itself—nationalization, state planning, and the massive expansion of social policies. Second, Castro's accession to power in 1959 was immediately followed by strict economic sanctions imposed by the U.S. and a full economic embargo beginning in 1962. Third, in alliance with Cuba, the Soviet Union began heavily subsidizing the Cuban economy in the 1960s and continued supporting Cuba until the collapse of the USSR. These factors pull in different directions and contribute in unique ways to the interpretation of what caused the reversal. For example, if the embargo had the largest effect of the three, then the reversal is a trade

[1] Appendix A provides a discussion of Cuban living standards throughout the 20th century, offering the context for this brief summary.

[2] A classic example is the comparison of Canada and Argentina. At the start of the 20th century, Argentina was wealthier than Canada, but over the next 100 years, this trend reversed, creating a significant gap (Glaeser et al., 2018), making Argentina one of the major cases of economic reversal. However, this example is not unique. Some surveys (see Appendix A) suggest that Cuba may have been on par with or even wealthier than Argentina.

story that is exogenous to Cuba. If Soviet subsidies fully offset the effects of the trade embargo, then the subsequent reversal can be attributed to the regime's socialist policies prior to the collapse of those subsidies with the fall of the Soviet Union. The key challenge is to disentangle these countervailing effects and estimate the independent impacts of the revolution, the embargo, and the subsidies. We do precisely that: separate causal factors and assess their relative importance.

To do so, we anchor ourselves to existing empirical attempts to measure the effect of Fidel Castro's rise to power using synthetic control methods (Jales et al., 2018; Geloso and Pavlik, 2021).[3] Synthetic control methods construct a counterfactual by creating a weighted combination of units from a donor pool (a set of similar economies or regions unaffected by the intervention) such that their pre-intervention characteristics closely match those of the treated unit. This synthetic unit serves as an estimate of what would have happened in the absence of the intervention, allowing researchers to isolate its causal impact.

However, existing results are heavily affected by data quality issues. Three major hurdles must be overcome when developing Cuban GDP estimates (Devereux, 2021). First, Cuban prices during the revolution were set by planners and do not reflect true economic value. Second, there is a concern about data manipulation in Cuban economic series.[4] Third, because Cuba followed the Soviet Material Product System (MPS) method of national accounting during the first three decades of the revolution, it is particularly difficult to compare its GDP to that of other countries. These data challenges help explain why, despite the revolution being a major event in economic history, so few studies have

[3] Geloso and Pavlik (2021) used the method with infant mortality rates as the dependent variable. Jales et al. (2018) found that while the embargo had an effect on GDP per capita, it was partly counteracted by Soviet assistance; however, the revolution's overall impact was larger. That said, Jales et al. (2018) make it clear that they do not believe they fully disentangled these effects. For example, they estimate their Synthetic Control from 1959 through 2000 and interpret the major divergence post-1989 as evidence that the Soviet subsidies were instrumental in propping up Cuba's economy. However, because the Synthetic Control Method requires forecasting in the post-treatment period, it is likely that at least part of this divergence is caused by poor prediction 30-years following the treatment. Moreover, while they see a marked decline in GDP per-capita in 1962, they are explicit in that they are unable to separate the embargo effect from the revolution itself given how close the two events occur to one another.

[4] As noted in Martinez (2022) and Alvarez et al. (2024), data quality issues and the inflation of GDP statistics are common problems in dictatorships, including Cuba. See Appendix A for a longer discussion.

empirically assessed its economic impact. Jales et al. (2018) rely on GDP measures that suffer from the very flaws outlined above.

To assess the importance of this issue, we turn to improved GDP measures—specifically those developed by Devereux (2021), which address all three key concerns—and compare them with the more conventional figures. We use the post-1957 movements from Devereux's estimates to construct an adjusted GDP per-capita series using the 1957 value produced by the Maddison Project Database (MPD; 2023) as the baseline. Because the MPD corrects national income for purchasing power parity (PPP), Devereux's estimates can be compared to other countries. This already significantly affects the interpretation of the total effect (i.e., the effect that combines the Revolution, the embargo, and Soviet aid). Second, we remove Soviet subsidies from national accounts and repeat our analysis. This is possible because, in addition to providing a more accurate representation of Cuba's GDP, Devereux (2021) also constructed annual estimates of Soviet assistance to Cuba. These estimates include both direct aid and subsidies, and benefits from favorable trade agreements (e.g., purchasing Cuban sugar at above-world prices) – for brevity, we call these simply "Soviet aid."

[Insert Figure 1 Here]

Figure 1 below summarizes our results. The dashed red line represents the counterfactual Cuba — that is, Cuba without the Revolution, the U.S. trade embargo, or Soviet aid. The orange line shows the "conventional" data, while the green line depicts the corrected estimates from Devereux (2021). As shown, under the corrected series, Cuban GDP per-capita is 46.7% below the counterfactual by 1975 and 44.3% below by 1989—considerably more than under the conventional estimates (31.3% and 19.4% respectively). The blue line in Figure 1, which removes the effect of Soviet subsidies, shows that by 1975 Cuban GDP is 52.1% below the counterfactual, and by 1989 the gap is 55.4%. These figures reflect the combined impact of the Revolution and the U.S. trade embargo (net of Soviet

Aid which amounted generally to 20% of GDP).[5]

This leaves only the issue of isolating the effect of the US trade embargo. A great deal of ink has been spilled on that topic as it is argued to either explain nothing or all of the reversal of fortune (Losman, 1974; Garfield and Santana, 1997; Barry, 2000; Drain and Barry, 2010; Gordon, 2016). Here we use three sets of trade data (i.e., total trade in the form of exports plus imports) to create a range of estimates. The first is based on Cuba's total trade with all other countries. This is the most realistic of our estimates. Again, we use the synthetic control method based on a donor pool of similar countries pre-1959.[6] Total trade is then re-expressed relative to GDP to arrive at a figure of trade openness which we connect to the literature connecting that concept to economic growth (Yanikkaya, 2003; Raghutla, 2020). We adjust the GDP number to work in the lost trade and find that GDP per capita would have been 3.3% higher without the embargo – accounting for a trivial portion of the Revolution's effect.

The second and third are based on US-reported data about total trade with (and imports from) other nations.[7] These are meant to create upper bound estimates of the embargo's effects as we implicitly assume that trade with other countries remained constant (i.e., no redirection after embargo from US) and that all the loss of trade is the loss of US-related trade. With these less realistic assumptions designed to overstate the effect of the embargo, we find that GDP per capita would have been 7.6% to 10.6% higher without the embargo. This means that, at best, the embargo explained between $\frac{1}{8}$ and $\frac{1}{5}$ of the difference between the actual and counterfactual GDP per capita (net of Soviet aid).

The embargo hurt, but it was of secondary importance in explaining Cuba's reversal of fortune. These results, combined with the fact that many of the regime's most extreme

[5]In Appendix F, we present an alternative approach to disentangle the effects of subsidies and the regime's policies by constructing a synthetic counterfactual using a donor pool of Soviet bloc countries at the time of the USSR's collapse. This allows for a comparison between economies that adopted market reforms and Cuba, which implemented some reforms but far fewer. Like Cuba, these countries lost Soviet subsidies but were not subject to the U.S. embargo. We find that from 1989 to 2000, a synthetic predicts faster economic growth than Cuba actually experienced. However, these results are not significant.

[6]This data is that which is reported by Cuba's government and could be manipulated.

[7]This data is not subjected to manipulation.

policies were not implemented until the 1960s, give us confidence that the massive decline in Cuban economic performance can be primarily attributed to the revolution rather than external foreign policy. This, we argue, supports the claim that avoiding certain conditions is sufficient for growth: a socialist economic structure, extreme privation of civil and political rights, and autarky (Sachs and Warner, 1995). Of these, only one – autarky – was exogenously imposed by a major trading partner (and not by all nations which means that we are not talking about full autarky), yet it fails to explain much of Cuba's decline, suggesting that the first two factors alone are sufficient to account for its reversal of fortunes. This is also consistent by recent work produced by Bergh et al. (2025) and Benzecry et al. (2024). The former is particularly relevant as it considers the growth consequences of countries that adopted socialism and find that there is substantial slowdown. Moreover, their average treatment effect (as their work is causal) produces an estimate largely similar to ours.

We organize the remainder of our paper as follows. Section 2 provides a brief overview of the revolution and summarizes the existing literature surrounding this topic. Section 3 discusses the data and methodology. Section 4 presents the results. Section 5 concludes. We also provide multiple appendixes discussing data, providing results with alternative datasets for GDP, trade and specifications for the effects of revolution. Appendix A provides a long bibliographical essay with multiple details regarding national accounts for Cuba that would make the present article too long. Appendix B does the same thing with the finer details of the America embargo. Appendices C through F show multiple robustness checks that confirm the validity of our results.

2 The Revolution, the Embargo, and Soviet Aid

Economic history often involves uncertainty in estimating living standards due to data quality limitations. However, we are certain of specific stylized facts (we discuss them in greater detail in Appendix A) with respect to Cuba. First, Cuba was among the wealthiest

countries in the Americas before the Revolution, trailing only the United States, Canada, and possibly Argentina. It was also relatively affluent by global standards, surpassing even some countries of Europe such as Italy or Greece at points in time.

Second, official growth figures reported by the Cuban regime are widely believed to be overstated (see Appendix A for a discussion), meaning that any assessment of Cuba's relative performance is likely inflated as well. Only recently have we obtained a continuous "corrected" GDP series, thanks to Devereux (2021). Yet, even using the uncorrected (low-quality, potentially manipulated) data, Cuba no longer ranks among the richest countries in the Americas. It is now poor by global standards, lagging behind many African and Asian nations it once surpassed, and far behind European ones. Clearly, Cuba represents a case of a reversal of fortune.

The third is that there are three interrelated causal forces at play with different timings that can explain Cuba's growth path: **a)** the Revolution itself, which restructured the economy; **b)** the American embargo, which restricted trade and investment and; **c)** Soviet financial aid, which propped up the economy until the USSR collapsed. Each of these factors requires discussion to clarify their expected effects on Cuba's growth path and to connect our findings to the broader question of why some countries experience reversals of fortune.

2.1 The Revolution and the Policies

In 1959, when Fidel Castro seized power, he initiated what can only be described as a rapid series of reforms toward socialism (Dominguez, 1978; Koplan et al., 2001; Herrera, 2023).[8] Large farms owned by foreigners were nationalized first, including the all-important sugar production sector as well as the cigar manufacturing sector (Jones, 2019). Many sectors of the economy were nationalized to conform with the centralized

[8] Herrera (2023) is used as a source because he produced the academic work most favorable to the regime. His descriptions are thus those that have a pro-regime bias. Hence, when he declares (in French) that the "transition to socialism" took place in "a very rapid historical pace", we believe that describing the reforms as "rapid" is accurate (p. 135, translation is ours).

planning of the economy. The aim of the first central plans was to extricate Cuba from its long-standing reliance on sugar exports through industrialization. Simultaneously, there were considerable increases in government spending on health care, education (to enhance the skill sets necessary for non-sugar industries), and the armed forces. However, in the regime's first years, significant forms of "capitalist property" remained in co-existence (Herrera, 2023, p. 136).

The initial central plans failed, and the Castro regime was forced to continue relying (increasingly so) on sugar exports. Soviet subsidies, tied to sugar prices, as we will discuss below, only reinforced that reliance. When it became apparent that the first plans had failed, the government doubled down on state ownership with a second agrarian reform (expropriating mid-sized farms in 1963) and later nationalized industries related to tourism, such as restaurants, bars, and street food outlets (Jales et al., 2018).

By the early 1970s, the regime had failed to meet its objective. In fact, it had attempted to recreate Mao Zedong's steel target during the Great Leap Forward (1958–1962) to surpass the United Kingdom in steel production within 15 years. The only difference was that "steel" was replaced by "sugar," with an ambitious target of 10 million tons—which failed despite significant additional inputs. Minimal relaxations of socialist policies were enacted after that point, with the easing of some restrictions on foreign investment.[9] It is only after the collapse of the USSR that the Cuban regime made a series of important pro-market reforms without going as far on the road to a market economy as former Soviet economies of Eastern Europe.

What should we expect from these reforms? We know that it is an empirical regularity that countries that adopted socialist economic policies (i.e., the nationalization of the commanding heights of the economy and other means of production) tend to be poorer (Sachs and Warner, 1995; Easterly and Fischer, 1995; Benzecry et al., 2024; Bergh et al.,

[9]For example, Decree Law 50 of 1982 authorized foreign private investors to form joint ventures as minority partners with state-owned enterprises (Koplan et al., 2001, p. 3-7). It also reformed the tourism sector to allow foreign private partners, as well, shortly before the end of Soviet aid to Cuba (Koplan et al., 2001, p. 3-8).

2025).[10] But that says little about the mechanism. Two families of explanations coexist regarding the mechanisms.

The first is that planning is essentially based on past economic data and cannot adapt to changes in circumstances due to the lack of price information. The plans are constructed using mostly rear-view mirror information (von Mises, 1981; Hayek, 1988; Boettke, 1999, 2013; Benzecry et al., 2025). This means that economic calculation is impossible due to knowledge problems that prices previously helped solve. In turn, error corrections become impossible and this slows down growth (Czeglédi, 2014) This explanation does not require assuming anything about incentive compatibility of planners.[11] The planners are assumed to be benevolent actors.[12]

Another explanation is the public choice perspective, best argued by Levy (1990). He contends that the central planner, in setting controlled prices, has incentives to do so in a way that maximizes his wealth, stemming from the fact that he controls access to the resources he is planning with (see also Buchanan, 1999, p. 87-89). This relaxation of the benevolent actor assumption helps explain a common finding—when using general equilibrium prices—that prices set for multiple goods in central plans in the Soviet bloc were *always* below market-clearing levels (i.e., the errors were not random) (Peck and Richardson, 1991).[13] Because of their control over resources, planners (and their agents) can engage in rent-seeking which — ultimately — set socialist economies of a path of poor economic performance (Anderson and Boettke, 1997; Shleifer and Vishny, 1992).[14] Both families can coexist as they offer non-mutually exclusive explanations for the empirical

[10]For more localized studies, see Kukić (2020) regarding Yugoslavia, Boettke et al. (2023a) regarding Estonia, Boettke et al. (2023b) regarding Poland, Das et al. (2021) regarding India, Harrison (1993, 1998, 2000, 2017) for the USSR and Russia, and Vonyó and Klein (2019) for a comparative analysis Czechoslovakia, Hungary and Poland. See also Geloso and Ritschl (2025) for a discussion of East Germany.

[11]Central planners might self-interested individuals who arrange the plans to serve their own interests, misaligning with the disinterested pursuit of maximizing the social welfare function

[12]Implicitly, they use a rhetorical tactic based on giving as much room as possible to the view they criticize (i.e., that centralized planning is possible).

[13]David Levy recounted to one of the authors of the present article that Paul Samuelson once mentioned to him how he had found that the only centrally fixed price in the Soviet Union that was not below what could be deemed the market-clearing price was that for cabbage.

[14]Arguments regarding soft-budget constraints (i.e., state-owned enterprises operating without concern for losses) can be considered to be part of that second family (Kornai, 1986; Boettke and Candela, 2021).

regularity of disappointing economic improvements under socialism.

This description implies that, aside from the effects of the embargo and Soviet aid discussed below, the Revolution's impact should intensify as the regime tightened its control over the economy and diminish as it shifted toward more pro-market policies.

2.2 The Embargo

The problems posed by the embargo are manifold. First, the embargo and the revolution occur at the same time. Disentangling the effects is difficult. Second, as we explain in Appendices A and B, there are a wide array of estimates of its costs with the highest, of $1.34 trillion since 1959, being proposed – unsurprisingly – by the Cuban government. The lowest – also unsurprisingly – are those from American government agencies (which are slightly below 1% of Cuban GDP in the 1990s). Third, the methodologies for all estimates we found rely on a great deal of information that is hard to verify or that are merely approximations. Fourth, the most frequently cited estimates—those from the Cuban government—do not rely on general equilibrium or structural modelling. Instead, they are based on a large number of assumptions that are simply aggregated with questionable reliability. Other estimates, which use more robust methodologies such as trade gravity models, are only available for the years 1996 to 1998 and involve debatable specification choices that may bias the results (Koplan et al., 2001).

Already, these problems are daunting. However, there is a fifth one: relating the effects to GDP. One has to remember that GDP is not an economic identity but rather an accounting one. This matters because we have to remember that a trade embargo reduces both exports and imports. In the usual GDP identity, NX (net exports representing the trade balance) will have changed but so will NCO (net capital outflow representing the capital account) since $NX = NCO$ by accounting convention. However, for open economies, the I (investment) in the GDP accounting identity is $I = S - NCO$ where S is savings.[15] This means that changes in NX end up being canceled in the accounting

[15] In open economies, $S = I + NCO$.

identity. Ergo, manipulations of the accounting identity would return that a change in NX has no effect on GDP.[16] Again, this is because we are dealing with an accounting identity. Picking either exports, imports, or net exports as a data series to estimate a counterfactual Cuba without the embargo is thus virtually impossible to work into the accounting identity of GDP without violating key assumptions that allow connection with economic identities.

To relate the effects of the embargo in terms of well-being, we must establish that changes in NX (net exports) impact capital flows in ways that hinder productivity and its growth. This occurs through substitution effects – where restrictions on trade limit access to capital goods and essential inputs – while also affecting consumers by inducing a shift toward less desirable substitutes for imported goods.[17] The key link between trade and well-being lies in how changes in NX affect production. Any counterfactual estimate of the embargo's impact on GDP components must be grounded in the role of trade in shaping production capacity and efficiency.

An obvious measure comes to mind: total trade (the sum of exports and imports). As a widely used indicator of trade openness, often considered synonymous with a country's integration into world trade, it frequently appears in studies examining the relationship between trade and economic growth (Yanikkaya, 2003; Huchet-Bourdon et al., 2018; Raghutla, 2020).[18] If a synthetic-control constructed counterfactual for Cuba shows that trade openness remained unchanged—after redirecting trade to countries other than the United States—then the embargo can be considered ineffectual in reducing Cuban living

[16]This is visible if we rewrite the GDP identity as $Y = C + I + G + NX$ and replace the relevant parts: $NX = NCO$ and $I = S - NCO$. This means $Y = C + S - NCO + G + NX = C + S + G$ which shows why we cannot easily insert a counterfactual NX effect of the embargo into a counterfactual GDP estimate.

[17]Irwin (2005) provides a detailed discussion of this effect.

[18]In practice, this is precisely what Jales et al. (2018) attempt to do through mediation analysis, incorporating exports in the construction of counterfactuals to isolate the role of the embargo. Their findings suggest that export fluctuations significantly influenced Cuba's GDP in the 1960s but had little impact thereafter. As a result, they align with the claims of US governmental agencies that argue that the embargo has minimal effects on Cuba's economy. However, the estimates of Jales et al. rely on flawed Cuban data, which likely leads to an overestimation of the embargo's effects. The parameter they derive is biased upward, meaning their results may exaggerate the extent to which the embargo, rather than other factors (i.e., the revolution), shaped Cuba's economic trajectory.

standards. However, if the counterfactual suggests lower trade openness, we can connect this outcome to existing studies linking openness to income. For example, if a 1% increase in trade openness is generally associated with a 0.186% increase in economic growth,[19] we could use this proportion to estimate the economic cost of Cuba's loss of openness due to the embargo. This will constitute our main strategy (what we deem to be our most realistic assessment).[20]

We can also repeat this exercise under an alternative and deliberately extreme assumption that allows for a larger estimate of the embargo's damages. Specifically, we will assume that Cuba's entire trade prior to the embargo was exclusively with the United States. Under this assumption, the imposition of the embargo would have resulted in a complete collapse of Cuba's external trade, without any offsetting trade reallocation to other partners. This implies that no compensation occurred through trade diversification, and therefore, any loss in trade volume is magnified. While this scenario is clearly unrealistic—Cuba did, in fact, reorient much of its trade toward the Soviet bloc and other non-Western countries—it serves an analytical purpose.[21] It allows us to test the upper bounds of the embargo's possible economic damage, under the premise that trade with alternative partners was less productivity-enhancing than trade with the United States would have been. In doing so, we acknowledge that while substitution occurred, it may not have been equivalent in terms of economic benefit, particularly if trade with the Soviet bloc was driven more by political alignment than by economic efficiency.

Finally, it is important to acknowledge that all approaches are inherently biased toward producing larger estimates for the impact of the embargo. Our designs attribute all declines in trade solely to the embargo. The simultaneity issue (i.e., embargo and revolution occurring at the same time) remains unresolved. The revolution, by making firms less productive and imports costs higher, could have changed openness regardless of

[19]This figure is based on Raghutla (2020), not a fictional estimate.

[20]In Appendix E, we will replicate our results with exports and imports separately to see if they are consistent.

[21]Before the revolution, around 69.1% of Cuba's trade was with the U.S, and although Cuba's trade with the USSR was negligible before 1959, it had risen to 49.3% of Cuban trade by 1962 (LeoGrande and Thomas, 2002, 326).

the embargo. By adopting a methodology that relies on trade statistics which can then be related to GDP, we effectively favor the embargo's role in explaining Cuba's economic decline. Implicitly, our approach rules out any reduction in trade openness caused by the revolution itself, rather than the embargo. As a result, our estimates are intentionally upwardly biased, inflating the embargo's apparent impact. However, this bias also strengthens our conclusions: if, even under this approach, the embargo's effects appear smaller than those of the revolution, then we can be confident that this ranking holds.

2.3 Soviet Aid

The rise of a socialist leader to power meant a strong incentive for alignment with the Soviet bloc. Cuba's proximity to the United States made such an alliance even more appealing. With a trade deal in February 1960 (a little more than a year after the Revolution), the alignment was underway and, unsurprisingly, Soviet aid arrived rapidly after (with substantial foreign credits transferred in 1961–62) (Herrera, 2023, p. 144). Aid from the Soviet Union to Cuba peaked at $6 billion just before the former's collapse (Koplan et al., 2001, p. 3-3). This aid took three main forms: privileged access to Soviet markets for Cuba's key exports (sugar and nickel), above-market prices for sugar, and trade credits to finance the import of other inputs (notably oil but also other industrial inputs). (Walters, 1966; Radell, 1983; Pérez-López, 1988; Hernández-Catá, 2013; Herrera, 2023).

Of the three sources of aid, the above-market prices for sugar was the most important. Herrera (2023) points out that the Soviet-offered price per pound of sugar was always at least 25% above the world price with brief exceptions in 1963 and 1971. On average, the price difference was more than 100% until 1973 (Herrera, 2023, p. 155). However, in the late 1970s, the gap surged such that by the 1980s, the Cuban government was getting close to 11 times the world price per pound (Pérez-López, 1988, p. 128).[22]

[22]Before 1959, Cuba also received a similar type of aid from the United States, though on a smaller scale (Herrera, 2023, p. 155). In his supplementary materials, Devereux (2021) estimates this aid at between 2% and 3% of GDP. By contrast, he finds that Soviet-era aid consistently exceeded 5%, except

This was substantial aid. In Appendix A, we explain how Devereux (2021) arrived at conservative estimates of the aid received from all planned economies (Soviet Union and Eastern Bloc) relative to GDP. Suffice to say that by 1962, Soviet assistance was already equivalent to 10% of Cuban GDP. By 1968, it reached 20%, peaking at 28% in the early 1980s. By the USSR's collapse, it stood at 20% of the economy.

How can we disentangle the effect of the Revolution from that of the subsidies? Unlike the case of the embargo, the logic here is more straightforward. Many of the regime's investments were funded by Soviet support (e.g., hospitals, schools, sugar refineries, nickel extraction, etc.), all of which then influenced the rest of the economy. By subtracting Soviet subsidies from GDP and examining "Cuba-specific" GDP (for lack of a better term), we can assess how efficiently the Revolution's policies used Soviet support to enhance the Cuban economy's productivity. To isolate the effect of Soviet aid from the other two factors, we estimate our results using GDP with and without Soviet aid. The difference between the two should reveal the independent effects of both the Revolution and Soviet support.

3 Data and Methods

3.1 GDP Series

One of the major contributions of our paper is to reevaluate the effect of the revolution after incorporating superior GDP estimates for Cuba. Thus, we begin this section by detailing the Devereux (2021) GDP per-capita index and how we use this index to adjust Cuba's series and what issues the new series is responding to.

In Appendix A.2, we detail the five broad issues plaguing commonly-used estimates of Cuban GDP: (a) statistical fabrication by the regime – something that is common to dictatorships (Devereux, 2021; Martinez, 2022; Alvarez et al., 2024); (b) the difficulty of adjusting Soviet-style national account systems (known as Material Product System or

for a near-zero level in 1973.

MPS) to the commonly-used System of National Accounts (SNA) developed by the United Nations and; (c) the valuation of government services; (d) the usability of government-fixed prices to estimate output value and; (e) the creation of purchasing power parities to allow for cross-country comparisons.

All these issues raise doubts surrounding the magnitudes of results found in previous studies that aim to evaluate the economic impact of the revolution (e.g. Jales et al., 2018) as they use estimates with these flaws.[23] Devereux (2021) provides an imperfect solution to all four problems by creating an index of GDP per capita based on output prices from 1957 (i.e., pre-revolutionary prices) to weigh the different physical quantities. As we explain in Appendix A, Devereux makes assumptions that on net still overestimate growth from 1959 to 1990 but far less than other series.[24]

We therefore adjust the raw GDP per-capita series for Cuba using Devereux's adjustments. We assume the raw Maddison Project Database (MPD) estimate is correct for 1957 (notably with respect to PPP) and adjust GDP per-capita backwards using this value and the implied growth rates of the index. Our adjustment for each year, given in equation form, is as follows:

$$\text{GDP per-capita}_t = \text{GDP per-capita}_{1957} \times \frac{\text{GDP Index}_t}{100} \qquad \text{for } t > 1957 \tag{1}$$

The GDP per-capita value for Cuba in 1957, according to the MPD's latest (2023) edition, was \$2,922. We used the MPD pre-1957 as is since MPD and other sources very much align.[25] The significant changes come from the post-1957 adjustments (see Figure A1 in Appendix A). For example, in the year of the revolution (1959) the Maddison data would suggest that GDP per-capita in Cuba was \$3,006 whereas the corrected value is

[23] This would also affect works such as Geloso and Pavlik (2021) who focused on a different outcome variable (infant mortality) but who use GDP per capita as a covariate to create the SCM weights in the pre-treatment period.

[24] Also relevant is the fact his series appears more believable than those produced by the Central Intelligence Agency (CIA) and which covered only 1965 to 1975 (see Appendix A for discussion). The CIA estimates are disputed.

[25] The MPD already incorporates the revisions of Ward and Devereux (2012). In any case, the differences between the MPD and Devereux (2021) pre-1957 are trivial.

$2,805. This gap gets as wide as $1,543 in 1989.

The findings of Jales et al. (2018) suggest that the collapse of the Soviet Union led to a sharp decline in Cuba's per capita GDP, indicating that Soviet subsidies likely played a crucial role in sustaining the Cuban economy. However, the analysis in Jales et al. (2018) relies on projections made more than thirty years after the revolution, making them potentially unreliable. Fortunately, Devereux (2021) not only provides more accurate estimates of Cuban per capita GDP but also directly measures Soviet aid as a share of his estimated Cuban GDP (see Figure A4). We use his figures to adjust the GDP series from equation (1), yielding a "no aid" GDP series.

3.2 Trade Data

Our trade data was retrieved from three sources. First, our main synthetic control exercise considers the effect of the embargo on Cuba's total trade with the rest of the world. We rely on trade data from the Montevideo Oxford Latin America Database (MOxLAD) going back to 1920. The results estimated will then be expressed as share of GDP to estimate the economic losses from lesser openness.

Our second synthetic control exercise will consider only US-related exports. This is built in two steps. Our main source is the official trade data from United Nation's Comtrade database. However, because UN's Comtrade only goes back to 1962, we supplement it using the US-reported trade data from the *Statistical Abstract of the United States* for 1938 to 1961.[26] By any standard, Cuban trade with the US was massive. It represented 69.1% of Cuba's trade (LeoGrande and Thomas, 2002, 326),[27] and it was larger than US' trade with continental giants like Brazil, greater than that of all Central American

[26]Both databases reports trade with the United States *and* Puerto Rico for this era, such that we exclude the latter from the donor pool. Data from the Statistical Abstract was retrieved from the following yearbooks (in parenthesis): 1938-42 (1944-1945), 1943-46 (1949), 1947-53 (1955), 1954 (1956), 1955-59 (1960), 1960-63 (1964). We have deflated using the US GDP deflator (1957=100), as export- and import-specific deflators were not available for this era.

[27]As much as 86% of Cuban exports and 81% of its imports were to and from the United States between 1940 and 1944 (Santamaría García, 2011, 156). However, they were becoming somewhat less reliant on the U.S., having reduced the share of exports and imports to 64 and 74%, respectively, by 1955-1959.

countries combined, and about 70% that of Mexico, which had nearly five times the population of Cuba.

As mentioned above, we consider total trade relative to GDP as a measure of trade openness, which can be linked to productivity based on previous studies that relate openness to growth (Yanikkaya, 2003; Huchet-Bourdon et al., 2018). This will serve as our "realist" measure of the embargo. However, our upper-bound estimate of the embargo's impact will deliberately violate national accounting identities by assuming that the entire shortfall in exports to the United States represents the full cost of the embargo. By definition, this approach overstates the damages. However, if even this inflated measure fails to surpass the economic cost of the revolution, it will serve as a robustness check for the conceptual validity of our claims.

3.3 Predictor Variables

We describe our methodology in detail immediately below in Section 2.4, but note here that a key component of the Synthetic Control Method is to accurately predict the outcome of interest throughout the *pre*-treatment period. The goal is to create a synthetic Cuba that appropriately tracks actual Cuba in the pre-treatment period, and presumably shows what would have happened in Cuba throughout the post-treatment period had the revolution never occurred. This involves selecting indicator variables that the researcher believes to be important predictors of the outcome (i.e., predictor variables). Given the data concerns in Cuba, our predictor set is relatively limited. We include estimates of urbanization (urban share of the population taken from the *World Urbanization Prospects* produced by the United Nations in 2018) and average years of education (from van Leeuwen and van Leeuwen-Li, 2014). This indicator set is similar to the one used in predicting infant mortality after the revolution from Geloso and Pavlik (2021), but is much more limited that the one used in Jales et al. (2018). This is because we are choosing only indicators that we are reasonably certain have not been manipulated by Cuban officials. Moreover, unlike Jales et al. (2018), we include a set of lagged GDP per-

capita indicators as predictors to ensure a higher quality pre-treatment match (a common approach with SCM).

3.4 The Synthetic Control Method

Like Jales et al. (2018), we use the Synthetic Control Method (SCM) to evaluate the impact of the revolution and Castro's regime on the Cuban economy. The goal of this method is to construct a synthetic Cuba (i.e., the counterfactual) such that we can understand what would have happened to economic output had the revolution never occurred.[28] We compare the economic performance of this counterfactual with Cuba's actual GDP per-capita and attribute any difference to the combined effects of the revolution – i.e., this provides an estimate of the treatment effect.

Synthetic Cuba is constructed using a weighted-average of similar Latin American donor countries. We use weights that are non-negative and sum to one – i.e., a convex combination.[29] Therefore, the selection of donor countries is paramount to the plausibility of the resulting synthetic control. For our main estimates, we follow Jales et al. (2018) and utilize other Latin American countries with available data as potential donors.[30] Because the events occurring in Cuba were (at the time) unique, this selection of donor countries satisfies a key assumption of the SCM: the treatment only affects the country of interest.[31]

[28] See Abadie et al. (2015), Athey and Imbens (2017), and Abadie (2021) for detailed descriptions of this method.

[29] Some have suggested to allow for negative weights (Doudchenko and Imbens, 2016). This would enable donor countries to be selected that may or may not be within the convex hull of the treated unit. This could result in a better out-of-sample prediction. However, we maintain the assumption of non-negative weights to ensure the synthetic is constructed using only countries similar to Cuba. This is common in the empirical literature (e.g. Grier and Maynard, 2016; Peri and Yasenov, 2019; Geloso and Pavlik, 2021; Geloso and Reilly, 2024a; Cachanosky et al., 2025).

[30] We also include Ecuador, which is absent from Jales et al. (2018). In Appendix D, we replicate our analysis with Puerto Rico as well, though this comes at the cost of losing some years in the pre-treatment period and schooling as a predictor variable. Given Puerto Rico's status as a natural comparison point—due to American interventions, its history as a former colony, and its divergent economic trajectory—it was essential to test whether our results changed with its inclusion. However, the findings remain highly similar to those presented here, which is why they are relegated to Appendix D.

[31] In Appendix F, we also pursue a supplemental strategy where we aim to estimate the effect of the embargo, rather than the revolution, by estimating the effect of the USSR collapse beginning in 1989 on Cuban GDP per-capita. In this case, our donor pool changes to all countries that were communist in the

For both our main results (estimating the effect of the revolution and embargo) and our supplementary results (robustness checks in appendices),[32] the convex weights are selected according to a two-step procedure. The overall goal is to minimize the difference between the pre-treatment outcome in Cuba versus synthetic Cuba. However, for predictors that are important to determining this pre-treatment outcome, we also want to match along these characteristics. We employ an optimization procedure that searches all combinations of predictors and country weights that minimize the pre-treatment root mean squared prediction error (RMSPE).

As discussed above, once we have a synthetic control constructed we compare the evolution of synthetic Cuba's economic performance with that of actual Cuba. The difference between these two values is the treatment effect. To gauge the statistical significance of this treatment effect, we conduct permutation (in-place placebo) tests. A concern with the SCM is that the gap uncovered could be attributed to poor prediction (i.e., noise/chance). Therefore, for each donor country, we repeat the synthetic analysis and act as if the donor country was treated. That is, for our main results, we use 1959 as the treatment year for each donor country and construct its synthetic control. We compare the evolution of this synthetic control with that of the donor country, just as we do in Cuba. Next, we compare the size of this placebo effect (as there was no treatment) with the size of the effect we find in Cuba. We rank these effects and calculate Cuba's p-value as the proportion of placebo effects (i.e., the number of donor countries) that are larger in magnitude. But before ranking effects, we normalize all effects by dividing them

1980s so that we can match Cuba with a synthetic Cuba that also faced the same trade restrictions and had similar policies throughout the pre-treatment period. Only after the Soviet collapse did all other donor countries experience changes, whereas the political status in Cuba remained the same. In this sense, the treatment in this latter case is the absence of change - of which, Cuba is the only country subjected to.

[32] We have already referenced Appendices D and F in earlier footnotes. Appendices C and E provide additional robustness checks with two key modifications. In Appendix C, we use the 2013 edition of the MPD, which presents different initial conditions for Cuba relative to other Latin American and Caribbean countries. We reapply equation (1) using this edition, but the results remain largely unchanged. In Appendix E, we replicate our trade-based estimates of the embargo's impact using only exports and a donor pool of Latin American countries. This approach provides an estimate that falls between the "realist" and "upper-bound" scenarios of the embargo's cost. The findings indicate that while the embargo was economically harmful, its impact was not substantial enough to countermand the broader economic consequences of the Revolution.

by their pre-treatment RMSPE (root mean squared prediction error). This discounts large effects that are the result of poor pre-treatment fit. We also calculate two alternative p-values - two-sided, where we compare magnitudes regardless of the direction of the effect, and one-sided where we see if the placebo effects are larger in magnitude and in the direction of Cuba's effect (i.e., are they *more* negative). We conduct these permutation tests and construct both p-values for our main results (estimating the combined effect of the revolution) and all supplementary specifications. [33]

It is important to note that a key limitation of the Synthetic Control Method (SCM) is that the accuracy of the synthetic counterfactual can deteriorate as we move further from the treatment date. One major reason for this is that some donor units may themselves undergo similar policy changes, reducing their effectiveness as controls. Previous applications of SCM, such as Geloso and Pavlik (2021) on infant mortality and the Cuban Revolution, highlighted this issue, particularly as several Latin American countries adopted comparable policies—though not to the same extent as Cuba. That study placed greater emphasis on results observed by 1975. Following a similar rationale, we assign higher confidence to our 1975 results relative to later years. Nonetheless, we present results covering the entire duration of the regime for completeness.

4 Results

4.1 The Total Effect of the Revolution, Soviet Aid and Embargo

We begin by assessing the combined effect of the 1959 revolution using the MPD estimates without adjusting the GDP series or accounting for Soviet aid. This serves to anchor our findings to those of Jales et al. (2018). The results are displayed in Figure 2, with the corresponding pseudo p-values shown in Figure 3. The first column of Table 1 shows the weights assigned to donor countries and the RMSPE for the specification. The top panel

[33] For brevity, we report and discuss only the two-sided p-values but note that the one-sided are available upon request.

of Table 2 summarizes the predictor variables. The emerging pattern indicates that, in the initial years of Castro's regime, actual Cuba and its counterfactual counterpart exhibit minimal divergence. However, as the second wave of nationalizations begins after 1963, a noticeable gap emerges, becoming increasingly pronounced by the 1970s. The gap then narrows in the late 1970s and 1980s, coinciding with a significant increase in Soviet aid. During this period, the USSR dramatically escalated its support by offering Cuba prices for its exports—particularly sugar—that far exceeded world market levels. While initially set at two to three times the world price, these preferential rates surged to between eight and eleven times the global market price by the late 1980s. This substantial increase in Soviet assistance likely played a key role in closing the gap that emerged up the 1970s. These results closely mirror the findings of Jales et al. (2018), despite their reliance on an entirely different data series. Consequently, the choice between the unadjusted MPD and the alternative dataset used by Jales et al. does not alter the overall conclusions.

[Insert Figures 2 and 3 Here]

[Insert Table 1 and 2 Here]

Next, we replicate our result but we shift to the corrected GDP series of Devereux (2021). Again, we are comparing the total effect of the Revolution, the embargo and Soviet aid. The result can be seen in Figures 4 and 5. The second column of Table 1 shows the weights assigned to donor countries. The RMSPE is also reported. The middle panel of Table 2 summarizes the predictor variables. The differences emerge much earlier – even before the second wave. Again, the gap falls in size in the late 1970s and early 1980s – reflecting the ramping up of Soviet aid.

In the first two columns of Table 3 below, we summarize the differences between the treated Cuba and the counterfactual Cuba with the MPD and the corrected GDP series. As can be seen, the differences are pretty sizable and suggest that the total effect was

negative.

4.2 Soviet Aid's Effect

Regardless of the underlying measure of GDP per-capita data used, one thing that is apparent in Figure 4 is that while the immediate effects of the revolution might be negative, the Cuban economy begins to catch-up to its counterfactual in the 1980s. As suggested, a likely explanation for this is the massive influx of Soviet subsidies. An explanation that can be evaluated with the removal of Soviet aid as estimated by Devereux (2021) from the GDP numbers. Figures 6 and 7 present those results that are analogous to Figures 2 and 3. The third column of Table 1 shows the weights assigned to donor countries, and again the RMSPE is also reported. The bottom panel of Table 2 summarizes the predictor variables. Because we are netting out Soviet assistance, the uncovered effects here correspond to a revolution *plus* embargo effect. As shown in the figure, the "catch-up" effect suggested in Figure 4 entirely disappears without Soviet support. The effects in general are also statistically more meaningful – though, again we lose significance in the 1970s likely when prediction errors are largest.

[Insert Figures 6 and 7 Here]

The third column of Table 3 presents the difference between the counterfactual and the treated unit. By 1975, it becomes evident that the regime had effectively stagnated, with the combined effects of the embargo and the Revolution driving this outcome.

4.3 The Embargo Effect

The final factor to disentangle is the impact of the embargo. Our results thus far already suggest caution in attributing significant causal weight to it. The embargo was substantially tightened in 1962, coinciding with a visible drop in our findings. However, the bulk of the decline observed in Figure 6 occurs between 1959 and 1962, rather than between

1962 and 1963. The contraction in the latter period is relatively minor by comparison, suggesting that factors beyond the embargo played a more substantial role in the initial economic decline.[34] Already, we should be skeptical of the claim that the embargo explains a great deal of the differences between the actual and synthetic paths of GDP per capita. We use three approaches to zero in on a range of estimates.

[Insert Figures 8 and 9 Here]

[Insert Tables 4 and 5 Here]

We aim to net out the effect of the embargo in three ways to create a range. First, we conduct the synthetic exercise of Cuba's trade with the United States. Figures 8 and 9 show the results and associated p-values. The first column of table 4 and the first panel of table 5 list the donor pool, associated weights, and predictor list for this result. Unsurprisingly, as Figure 8 shows, the embargo effectively halted Cuba's trade with the US. Our synthetic closely tracks Cuba along the pre-treatment period, with the exception of a spike in 1951, with is somewhat more pronounced in the synthetic counterfactual. However, by 1964, Cuba's trade with the United States was one-tenth of its 1959 value, and by 1965 it had fallen to virtually zero.

We can, albeit unrealistically, assume that the entire decline in trade with the United States—expressed as a share of GDP—represents a net loss that was not offset by increased trade with other countries.[35] This approach ignores both trade diversion toward other nations and the compensatory role played by the USSR and other planned

[34]However, the Revolution was also somewhat incremental. For example, it was not until 1963 that Cuba implemented the second - and more extreme - Agrarian Reform Law that expropriated land from farmers and brought 70% of farm land under government control (O'Connor, 1968). And it was not until 1961 that Fidel Castro made a public commitment to socialism (Medel, 2019).

[35]This assumption is equivalent to stating that Cuba's total trade volume fell by 46.4 percentage points of GDP. In 1957, prior to the Revolution, total trade accounted for 57% of GDP—implying a loss of more than four fifths of Cuba's initial trade openness. In reality, by 1972, that figure was at 48.6% suggesting that Cuba lost only a tenth of its initial openness level.

economies. It also ignores the potential effects of the revolution itself on trade. Consequently, it substantially overstates the true economic impact of the embargo. We then combine this decline in trade openness with estimates from Yanikkaya (2003), which suggest that a ten-percentage-point drop in openness (measured as the ratio of total trade to GDP) reduces annual per capita GDP growth by 0.18 percentage points. Applying this relationship to the observed contraction in trade share, we adjust actual GDP per capita upward by the implied effect captured in the synthetic counterfactual. By 1972—the final year for which U.S.-Cuba trade data are available—we estimate that Cuban GDP per capita would have been 7.6% higher in the absence of the trade shock. While this is a meaningful difference, it accounts for only 8.1% of the total gap between actual and synthetic GDP per capita attributable to the Revolution. Once the contribution of Soviet aid is factored in, that share drops further to 7.1%.

Another estimate—again, a highly exaggerated one—is derived by replicating our analysis using only exports to the United States rather than total trade. This result is presented in Figure 10, with corresponding placebo-test results shown in Figure 11. For brevity, the predictor variable for this unrealistic scenario are relegated to appendix. In this replication, we assume that imports remained fixed at their 1957 level, so that the exports predicted by the synthetic are treated as net additions to GDP. This assumption clearly violates the accounting principles of national income statistics (see Section 2.2), but this violation serves to intentionally inflate the perceived cost of the embargo and thus maximizes the estimated impact.

[Insert Figures 10 and 11 Here]

Does such an extreme assumption close the gap meaningfully further? The answer is: only marginally. Under this specification, GDP per capita in 1972 would have been 10.6% higher. While this estimate is slightly larger than the one based on the trade openness approach, it still fails to explain most of the divergence in GDP per capita

from the synthetic counterfactual. It accounts for just 11.3% of the total gap attributed to the Revolution. When the contribution of Soviet aid is incorporated, this share falls further to 9.9%. In other words, nearly nine-tenths of Cuba's under-performance relative to the counterfactual remains attributable to the Revolution itself. In other words, even a blatant violation of national accounting rules with unrealistic assumption fails to meaningfully explain the under-performance relative to counterfactual.

What would be a more realistic assessment of the embargo's cost? Any such assessment must account for the trade diversion towards with other nations. As the United States left, the Soviet Union arrived. Although Cuba's trade with the USSR was negligible before 1959, it had risen to 49.3% of Cuban trade by 1962 (LeoGrande and Thomas, 2002, 326). Cuba was also likely able to substitute in other margins with non-Soviet nations, as the United States was never able to fully coerce other countries into joining its embargo (LeoGrande, 2015). Thus, our third synthetic control exercise considers the effect of the embargo on Cuba's trade with the rest of the world. The results are reported in Figures 12 and 13 . The second column of Table 4 and second panel of Table 5 list the donor pool, associated weights, and predictor list for this result. As can be seen, we find some loss in total trade. However, the effect is not statistically significant.

[Insert Figures 12 and 13 Here]

The lack of statistical significance suggests that the embargo's impact on openness may be close to zero. If this holds, then the results in Figure 6 would represent the true effect of the Revolution. However, what if this finding is instead driven by data quality issues, the size of the donor pool, or other methodological factors? To address this concern, let us assume, hypothetically, that the results *are* significant—meaning there was indeed a measurable decline in openness by 1972 (ten years after the beginning of the embargo) as depicted in Figure 12. How substantial would this loss be for Cuba's economy? We replicate the strategy stated above with the US trade share and find

that, by 1972, without the US embargo, Cuba's GDP per capita would have been 3.07 percentage points above the actual figures.

By all accounts, the embargo damaged the Cuban economy – between 4.93% and 1.65% of GDP per capita by 1972. However, this widely fails to rival with the effect of the Revolution. This can be seen in Table 6 where we express the ratio of the synthetic GDP per capita to the actual data (with and without Soviet aid) with the different scenarios for the embargo's effect.

That proportion is not economically trivial. However, it is trivial when compared to the effect the Revolution. As shown in Table 6, only 3.07% of the difference between the actual GDP per capita and the counterfactual scenario for GDP per capita is attributable to the embargo. And readers should notice that we *assumed away* the non-significance of the results from the inference tests. That is, we technically found an effect indistinguishable from zero.

[Insert Table 6 Here]

Our findings are also supported by other studies that employ a wide range of causal methods. Most notably, Bergh et al. (2025) examined 22 developing countries that adopted socialism between 1950 and 2020. Using the two-stage difference-in-differences method developed by Gardner et al. (2024),[36] they found that the adoption of socialism was associated with an average decline in GDP per capita growth of 2 to 2.5 percentage points annually. In our case, the annualized difference in growth rates between the synthetic counterfactual and Cuba's actual GDP (excluding transfers) is 2.5 percentage points[37] – squarely within the range predicted by Bergh et al. (2025). This provides external validity to our findings by showing that Cuba's trajectory fits the broader pattern observed across a wide set of socialist experiences.

[36] Also see Callais et al. (2025) for a similar application.

[37] Using the difference in compound annual growth rates implicit from the overall growth from 1958 to 1989. The difference in *mean* annual growth rate is quite similar, at 2.27%. If we fit a time trend regression, the trend growth rate difference is 2.28%.

5 Robustness Checks

In this section, we describe a series of additional tests that assess the robustness of our results. We briefly describe these tests here, and provide further detail in their respective appendices.

5.1 Specification and Donor Pool

5.1.1 "Cherry picking"

Our first set of tests addresses the concern that, in synthetic control applications, there is room for discretion in choosing donors and matching variables, which could lead to specification search (Ferman et al., 2020). First, we apply the test proposed by Ferman et al. (2020) which entails using all pre-treatment lags of the outcome variable and no predictor variables (covariates). By including all lags, covariates become asymptotically irrelevant, reducing potential biases from specification search.[38] Section D.1 shows that our results are still significant when using all pre-treatment lags, albeit with somewhat smaller magnitudes.

5.1.2 Puerto Rico

We also perform two robustness checks with respect to our donor pool. First, we include Puerto Rico. In 1955, its income per capita was 30% that of the United States – Cuba's was 27% (Devereux, 2019), and its political economy resembled that of Cuba in many ways, as a comparable sugar-producing island in the Caribbean with commercial ties to the United States. Unfortunately, we do not have data on schooling for Puerto Rico, which prevents adding it to our main pool. In Section D.2, we show that our results do not change if we add Puerto Rico while removing schooling as a matching variable.

[38] For related discussions, see Kaul et al. (2015), Botosaru and Ferman (2019), and Ferman and Pinto (2021).

5.1.3 Jackknife test

The second test regarding our pool is a jackknife test, reported in Section D.3. We iteratively drop a single donor at a time and reestimate our results, to ease concerns that our results may be driven by a particular donor. Our results are largely unchanged in both magnitude and significance. Dropping Brazil generates noticeably smaller magnitudes, but they are still sizable and significant.

5.2 Alternative Data

5.2.1 GDP

In Appendix C, we replicate our results using the 2013 edition of the Maddison Project Database. The 2013 edition (relative to the 2023 one) reports level of GDP per capita that is 18% lower than the 2023 version in 1957, and 40% lower by 1989.[39] Using this alternative version of the data, we find comparable effects, both in terms of magnitude and significant.

5.2.2 Trade

In Appendix E, we replicate our results with data from Fouquin and Hugot (2016), which draws trade flows from different underlying sources. Our results are robust to this different trade flow estimates, and are likewise not significant when we consider the effect of the embargo on Cuba's trade with the world.

6 Conclusion

Cuba is one of the only remaining (nominally) communist regimes in the world, and the only one in Latin America. Due to generally limited and unreliable data, attempts to uncover the effects of the Cuban revolution are few with inaccurate estimates (Devereux,

[39] We provide an extensive account of the differences across different releases of the MPD project – see Appendix A, Section A.2.

2021). Moreover, the major diplomatic events following the revolution — Soviet aid starting in 1961 and the U.S. economic embargo in 1962 — make it difficult to isolate the economic effects of Cuba's transition to communism.

Our paper attempts to rectify these problems by first constructing a novel Cuban GDP series based on Devereux (2021) that does not rely on the regime's self-reported statistics and uses pre-revolution price levels. Our revised estimates suggest that the Cuban economy significantly under-performed its counterfactual by a larger margin than what was previously found in (Jales et al., 2018). By 1975, the Cuba was falling behind by 46.7%. The proportion was barely smaller, 44.2%, in 1989. However, this includes to Soviet aid. After accounting for Soviet aid and subsidies, our findings suggest an even larger gap between Cuba and its synthetic, reaching 52.1% in 1975 and 55.4% in 1989.

Finally, we shed light on the potential effect of the U.S. embargo by contrasting Cuba's economic course with that of fellow communist nations after the Soviet Union's dissolution. Despite the U.S. embargo only enduring in Cuba, our findings demonstrate that the embargo was of secondary importance to Cuba's reversal of fortune. While it did reduce income per capita, it can only account for a trivial part (less than a tenth) of the effect of the Revolution which is the most of all effects.

Before drawing broader lessons from our results, it is important to clarify what they do not capture. Readers will notice that we never extended our baseline results past 1989. Although the Cuban regime is in no way a market economy, the post-1989 period marked a movement towards some opening of markets (albeit modestly). Facing severe economic hardship after the collapse of the Soviet Union (i.e., during the Special Period), Cuba's government opened parts of the economy to private initiative and foreign investment.[40]

Our reluctance to extend after 1989 is, however, no great loss to the bigger issue: Cuba's reversal of fortune. The reversal took place during the period from 1959 to 1989. In fact, what is particularly telling is that – even without considering the difference with

[40]Moreover, pushing the synthetic control too far beyond the initial treatment introduces risks. If donor units themselves experienced significant institutional changes during the treatment period, it undermines the quality of the synthetic as a counterfactual.

the synthetic Cuba – Cuba's GDP per capita net of Soviet subsidies stagnated from 1959 to 1989: Cubans in 1989 were barely more productive than in 1959. Soviet aid was needed to boost living standards above the flagging productivity of Cuba.

Reversals of fortune, when they are invoked (Acemoglu et al., 2002, 2006), tend to take a very long-run view of institutions and development. Conditions in the distant past affected the path of institutional development, which later shaped economic development.[41] The process is thus one that historians affectionately label "the *longue durée*" (Braudel, 1958). While this may often be the case, there is no reason why a reversal of fortune cannot be rapid, sudden, and pronounced. Cuba fits that bill. Again, its living standards prior to the Revolution placed it at the forefront of Latin America and not dramatically far behind the United States, Canada and Western Europe (at least relative to today). It also enjoyed a decent growth trend to 1959. This makes the relative decline and the absolute stagnation a particularly extreme case of sudden, rapid and pronounced reversal.

We believe that this connects itself well to the work of Sachs and Warner (1995) who looked at what could be deemed "necessary conditions" for cross-country convergence in income. Those conditions are openness to trade and secure property rights. In Sachs and Warner (1995), countries essentially meet these conditions if they avoid socialism, autarky, civil repression (dictatorship) and violence (war with other nations or civil wars). Cuba failed to qualify on all counts (three by its own design and one as a result of America's embargo) – securing its reversal of fortunes. While economists might often be tempted to look further back in time to trace the origins of divergence across nations, it is not always necessary (or wise) to do so. Cuba offers an easy illustration of reversal beginning in the not-so-distant past and being completed within the living memory of most.

In fact, the reversal of fortune caused by the Revolution can be linked to persistent differences. When the origins of such a reversal lock a country onto a different economic trajectory, the effects can endure. This pattern is consistent with findings from other

[41] See also Engerman and Sokoloff (2012).

studies on the consequences of socialism. Most notably and recently, Bergh et al. (2025) examined 22 developing countries that adopted socialism between 1950 and 2020, using multiple causal identification strategies to assess its growth consequences.[42] They find that countries that adopted socialism experienced an average decline in GDP per capita growth of 2 to 2.5 percentage points per year, with comparable losses in productivity. More importantly, countries that remained socialist for longer periods—particularly those aligned with the Soviet Union—endured deeper and more prolonged post-socialist contractions than those that exited earlier or adopted milder forms. In other words, socialism "froze" the differences that it created even after it was gone. This can be tied to Cuba with the fact that its exposure to socialism – the inducer of the reversal – has only continued. This means that any transition process might be significantly harder than for other nations. This would cement the reversal of fortune for a long time to come.

To be sure, there is much that is still left uncovered. In particular, what specific policies of the regime were the main causes leading Cuba to forsake its place as one the richest nations of Latin America or to abandon any dream of closing the gap with the richest nations of the world. Was the agrarian reform the main culprit? Was it the nationalization of multiple industries? Was it the tight control on investment? These questions are necessary steps for firmer understandings of Cuban economic history. Moreover, the causal analysis impact of the reforms during the Special Period that followed the USSR's collapse is also a pressing item that could fuel our understanding of the divergence that continued after 1989. For now, however, we are content with our most certain contribution: the Revolution made Cuba forsake its previous path to greater prosperity, Soviet aid only masked how much was forsaken and only minor importance can be given to the American embargo. That, alone, is worthwhile.

[42]Socialism is defined strictly as regimes that implemented centralized planning and large-scale nationalization.

Tables and Figures

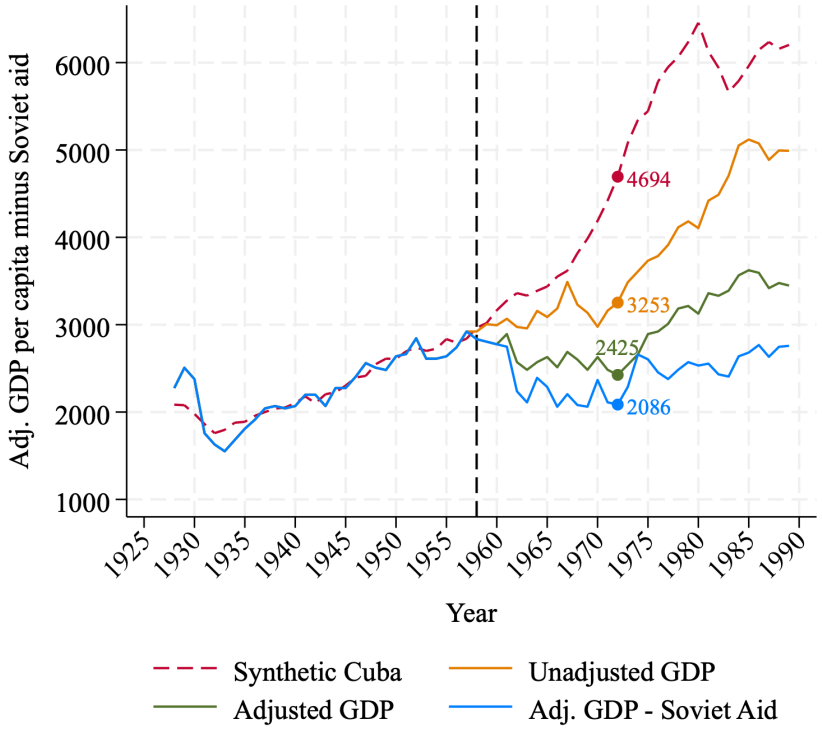


Figure 1: The Combined Effect of the Revolution: Raw GDP per capita from 2023 MPD

Notes: This plot shows the combined effect of the revolution and embargo, measured in 2011 Geary-Khamis dollars, using three different Cuban GDP series. The unadjusted series uses data from the 2023 Maddison Project Database (MPD); the adjusted series uses the 1957 level of Cuba's GDP series from 2023 Maddison Project and adjust it using 1957 onward using Devereux (2021); the last series deduct Soviet and Eastern Bloc aid, retrieved from Devereux (2020).

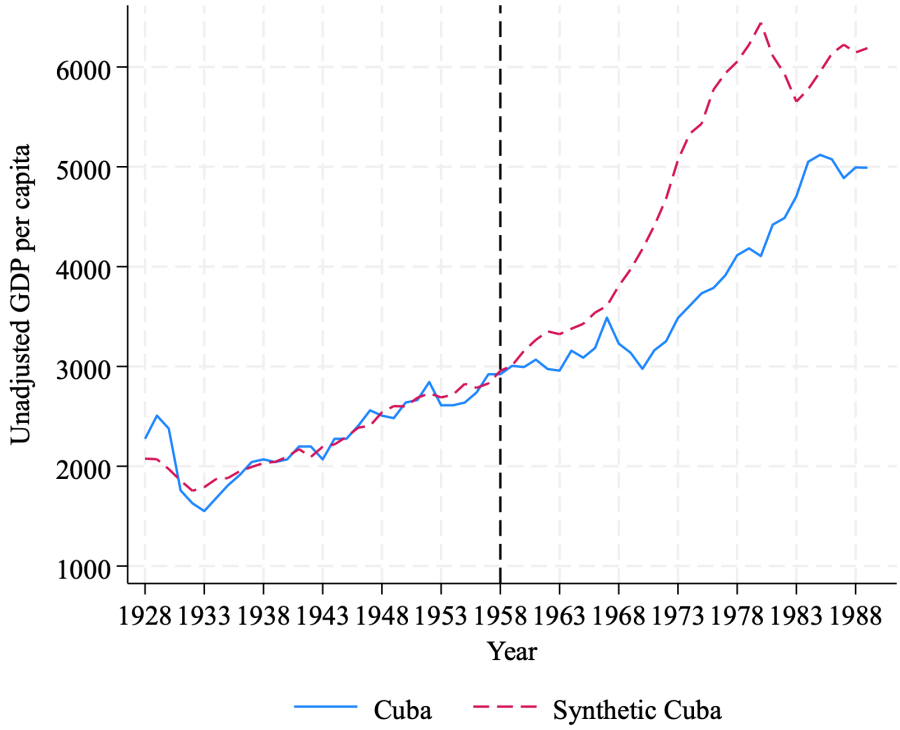


Figure 2: The Combined Effect of the Revolution: Raw GDP per capita from 2023 MPD

Notes: This plot shows the combined effect of the revolution and embargo, measured in 2011 Geary-Khamis dollars. Unadjusted data from the 2023 Maddison Project Database (MPD).

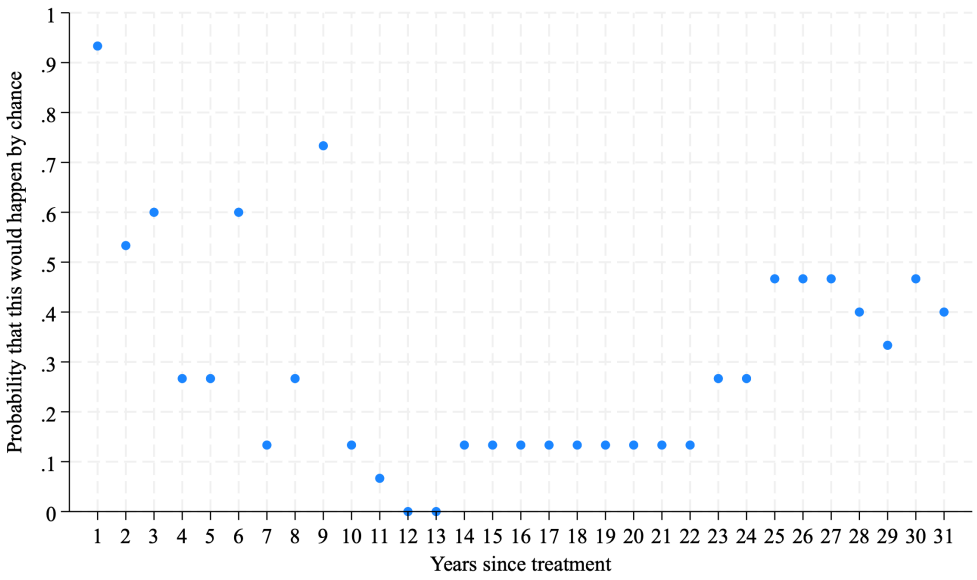


Figure 3: Standardized p-values: Raw GDP per capita from 2023 MPD

Notes: Standardized p-values for synthetic control using unadjusted data from the 2023 Maddison Project Database (MPD), see Figure 2 for main plot.

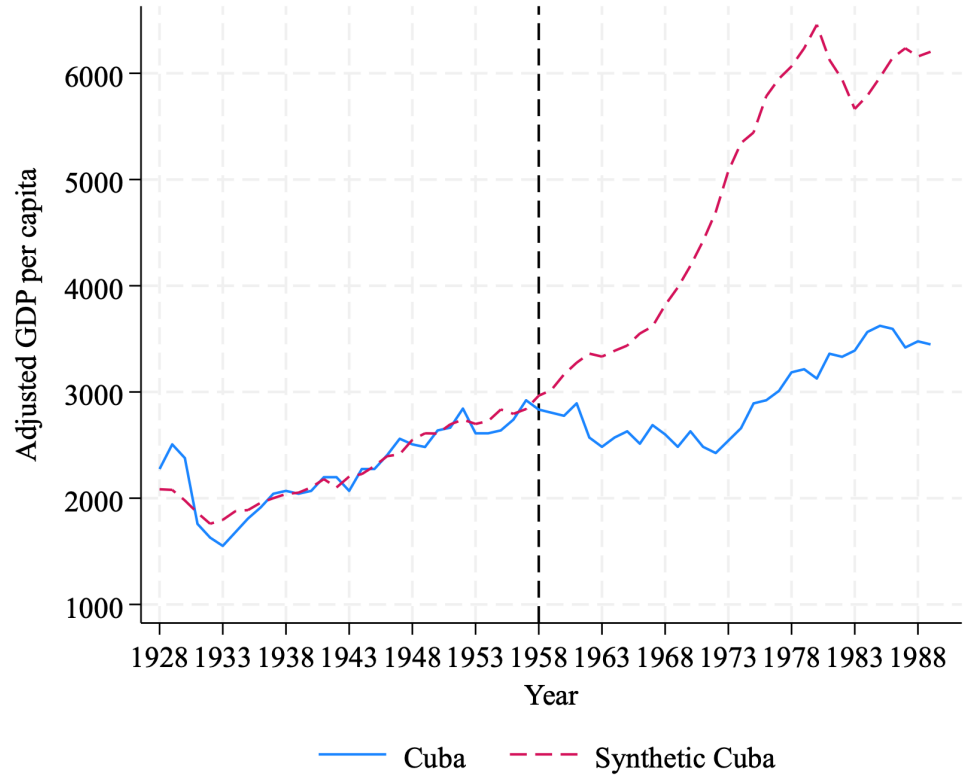


Figure 4: The Combined Effect of the Revolution: Adjusted GDP per capita

Notes: This plot shows the combined effect of the revolution and embargo, measured in 2011 Geary-Khamis dollars. We use the 1957 level of Cuba's GDP series from 2023 Maddison Project and adjust it using 1957 onward using Devereux (2021).

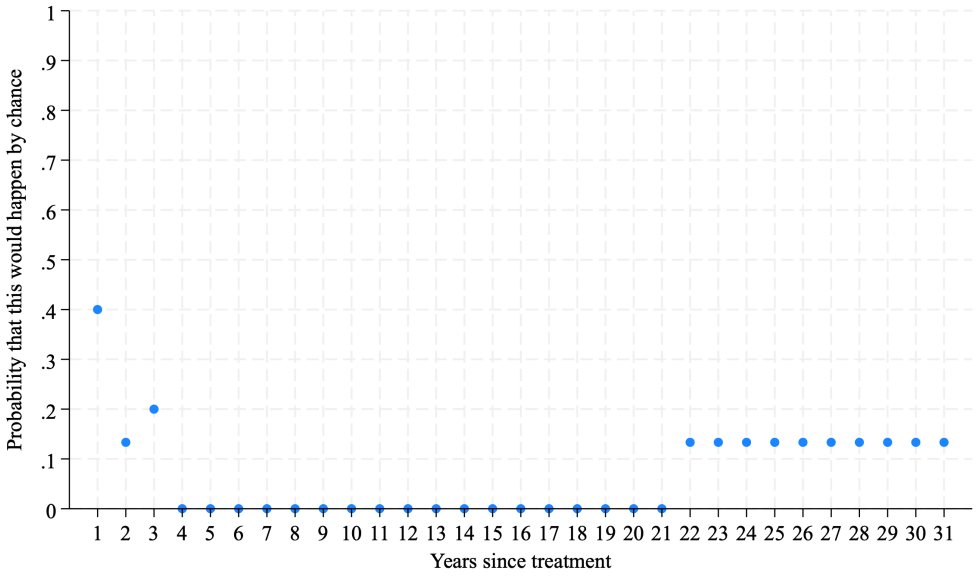


Figure 5: Standardized p-values: Adjusted GDP per capita

Notes: Standardized p-values for synthetic control using adjusted GDP data. See Figure 4 for main plot and details on adjustments.

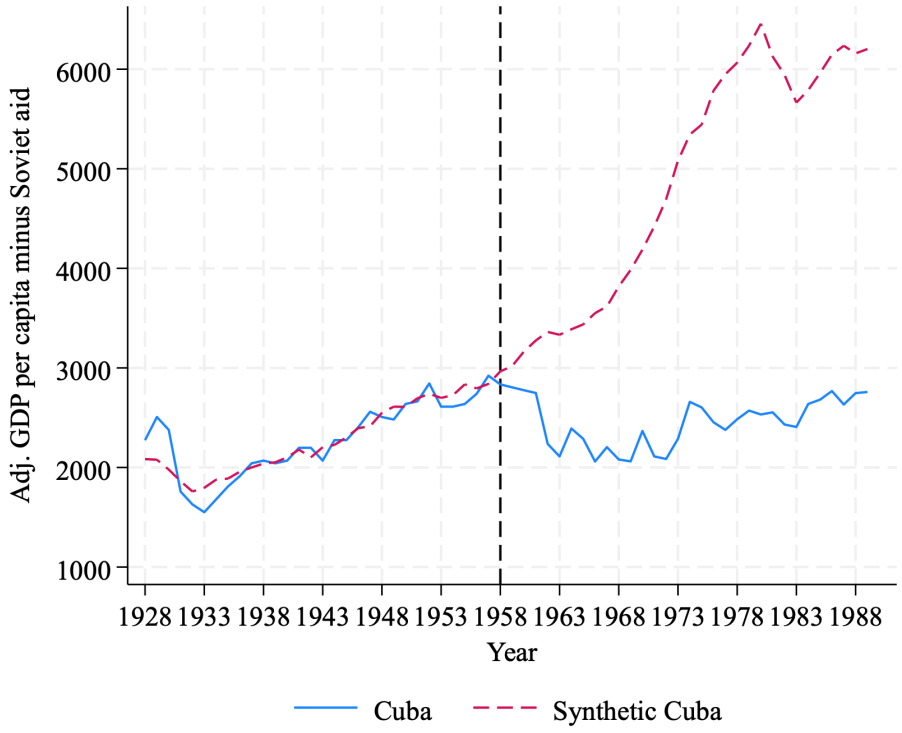


Figure 6: The Effect of the Revolution and Embargo
Net of Soviet Aid

Notes: This plot shows the combined effect of the revolution and embargo, measured in 2011 Geary-Khamis dollars. We use the 1957 level of Cuba's GDP series from 2023 Maddison Project and adjust 1957 onward using Devereux (2021), and deduct Soviet and Eastern Bloc aid, retrieved from Devereux (2020).

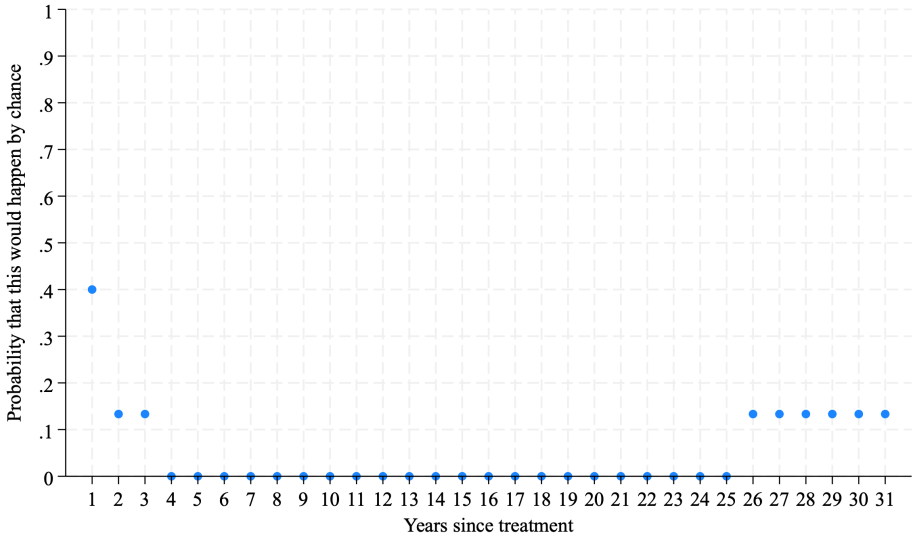


Figure 7: Standardized p-values: Adjusted GDP per capita
Net of Soviet Aid

Notes: Standardized p-values for synthetic control using adjusted GDP data, net of Soviet aid. See Figure 6 for main plot and details on adjustments.

Table 1: Donor Countries and Weights: Main Results

	Country Weights		
Donor Country	Unadjusted GDP per capita (Figure 2)	Adjusted GDP per capita (Figure 4)	Adjusted GDP per capita - Soviet aid (Figure 6)
Argentina	0.033	0.033	0.033
Bolivia	0.249	0.250	0.250
Brazil	0.523	0.523	0.523
Chile	0.007	0.008	0.008
Colombia	0	0	0
Costa Rica	0	0	0
Ecuador	0	0	0
El Salvador	0	0	0
Guatemala	0	0	0
Honduras	0.187	0.187	0.187
Mexico	0	0	0
Nicaragua	0	0	0
Peru	0	0	0
Uruguay	0	0	0
Venezuela	0	0	0
RMSPE	147.420	148.971	148.971

Note: Percentages may not sum to one due to rounding. Donors are nearly identical because our adjustment only affect 1958 in the pre-treatment period, and the Soviet aid adjustments just affect the post-treatment period.

Table 2: Predictor Variable Comparison for Cuba, Synthetic Cuba, and Predictor Weights

Panel A: Unadjusted GDP per capita - Figure 2				
Variable	Cuba	Synthetic Cuba	Donor Countries	V-Weight
Urban Share	56.985	34.970	42.393	0.000
Schooling	3.120	2.577	2.544	0.001
GDP per capita (1935)	1809	1881.636	2886.267	0.031
GDP per capita (1940)	2069	2094.475	3295.400	0.024
GDP per capita (1947)	2560	2406.422	3695.667	0.025
GDP per capita (1950)	2638	2600.010	4103.600	0.164
GDP per capita (1953)	2611	2689.854	4429.533	0.035
GDP per capita (1956)	2740	2785.434	4683.133	0.491
GDP per capita (1957)	2922	2829.996	4837.667	0.227
Panel B: Adjusted GDP per capita - Figure 4				
Variable	Cuba	Synthetic Cuba	Donor Countries	V-Weight
Urban Share	56.985	35.065	42.393	0.000
Schooling	3.120	2.585	2.544	0.001
Adj. GDP per capita (1935)	1809	1888.320	2886.267	0.031
Adj. GDP per capita (1940)	2069	2102.319	3295.400	0.024
Adj. GDP per capita (1947)	2560	2414.406	3695.667	0.025
Adj. GDP per capita (1950)	2638	2608.901	4103.600	0.164
Adj. GDP per capita (1953)	2611	2699.305	4429.533	0.036
Adj. GDP per capita (1956)	2740	2794.438	4683.133	0.492
Adj. GDP per capita (1957)	2922	2839.327	4837.667	0.226
Panel C: Adjusted GDP per capita minus Soviet aid - Figure 6				
Variable	Cuba	Synthetic Cuba	Donor Countries	V-Weight
Urban Share	56.985	35.065	42.393	0.000
Schooling	3.120	2.585	2.544	0.001
Adj. GDP p.c. minus Transf. (1935)	1809	1888.320	2886.267	0.031
Adj. GDP p.c. minus Transf. (1940)	2069	2102.319	3295.400	0.024
Adj. GDP p.c. minus Transf. (1947)	2560	2414.406	3695.667	0.025
Adj. GDP p.c. minus Transf. (1950)	2638	2608.901	4103.600	0.164
Adj. GDP p.c. minus Transf. (1953)	2611	2699.305	4429.533	0.036
Adj. GDP p.c. minus Transf. (1956)	2740	2794.438	4683.133	0.492
Adj. GDP p.c. minus Transf. (1957)	2922	2839.327	4837.667	0.226

Notes: The predictor balance for Figures 4, and 6 are identical because the Soviet aid only affects the post-treatment period. Unless a year is specified, values report the pre-treatment mean.

Table 3: Estimated causal effects

	Unadjusted MPD (Figure 2)		Adjusted MPD (Figure 4)		Adj. minus Soviet aid (Figure 6)	
Year	Effect	p-value	Adjusted Effect	p-value	Minus Transfers	p-value
1959	-4.737	(0.933)	-214.537	(0.400)	-214.537	(0.400)
1960	-161.963	(0.533)	-389.404	(0.133)	-389.404	(0.133)
1961	-198.273	(0.600)	-382.971	(0.200)	-527.610	(0.133)
1962	-377.869	(0.267)	-790.216	(0.000)	-1124.493	(0.000)
1963	-364.973	(0.267)	-849.351	(0.000)	-1221.906	(0.000)
1964	-219.633	(0.600)	-816.402	(0.000)	-996.397	(0.000)
1965	-338.851	(0.133)	-807.138	(0.000)	-1149.012	(0.000)
1966	-354.651	(0.267)	-1037.589	(0.000)	-1489.915	(0.000)
1967	-117.209	(0.733)	-929.029	(0.000)	-1412.912	(0.000)
1968	-577.293	(0.133)	-1217.080	(0.000)	-1737.196	(0.000)
1969	-835.592	(0.067)	-1500.458	(0.000)	-1922.687	(0.000)
1970	-1200.455	(0.000)	-1558.319	(0.000)	-1821.299	(0.000)
1975	-1699.079	(0.133)	-2550.040	(0.000)	-2839.318	(0.000)
1980	-2337.669	(0.133)	-3330.253	(0.133)	-3924.296	(0.000)
1985	-830.687	(0.467)	-2338.907	(0.133)	-3280.960	(0.133)
1989	-1198.170	(0.400)	-2754.623	(0.133)	-3444.215	(0.133)

Notes: The estimated causal effect is calculated as the difference (gap) between the actual Cuba and the synthetic counterfactual.

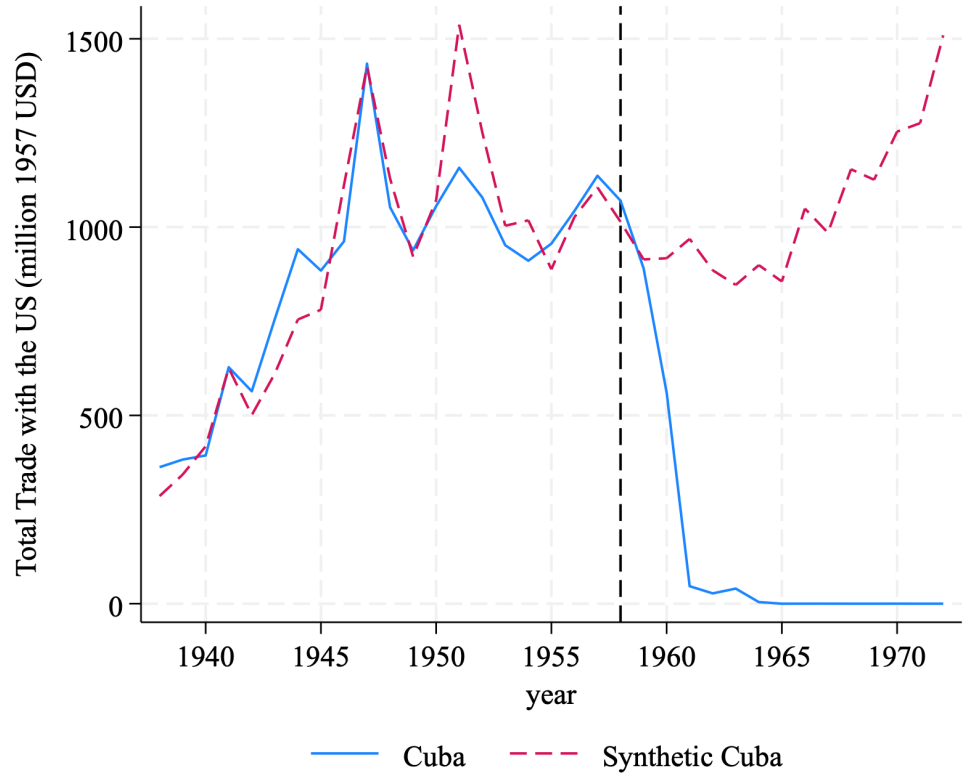


Figure 8: The Effect of the Embargo: Cuban Trade with the United States

Notes: This plot shows the effect of the American Embargo on Cuba's trade with the United States. Trade data comes from the *US Statistical Abstract* (1938-1961) and UN Comtrade Database (1962-1972).

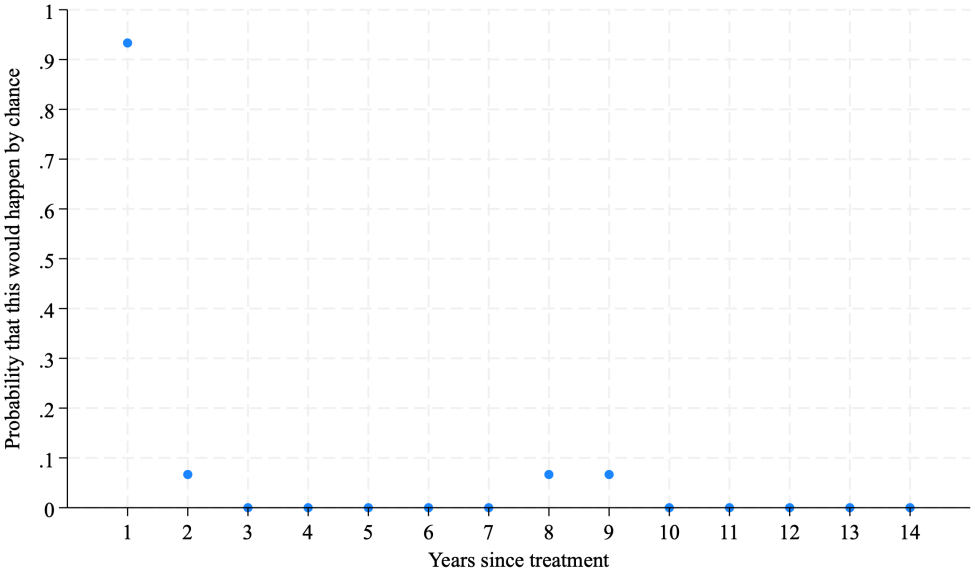


Figure 9: Standardized p-values: Cuban Trade with the United States

Notes: Standardized p-values for synthetic control on Cuban trade with the United States. See Figure 8 for main plot.

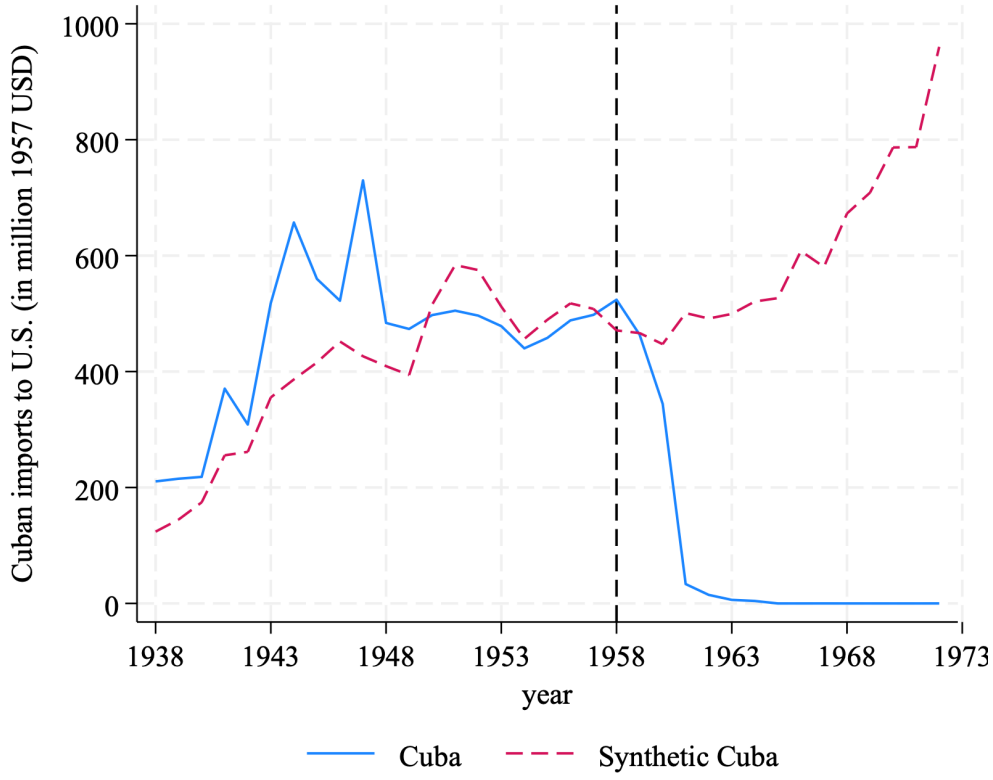


Figure 10: The Effect of the Embargo: Cuban Exports to the United States

Notes: This plot shows the effect of the American Embargo on Cuba's exports to the United States. Export data comes from the *US Statistical Abstract* (1938-1961) and UN Comtrade Database (1962-1972).

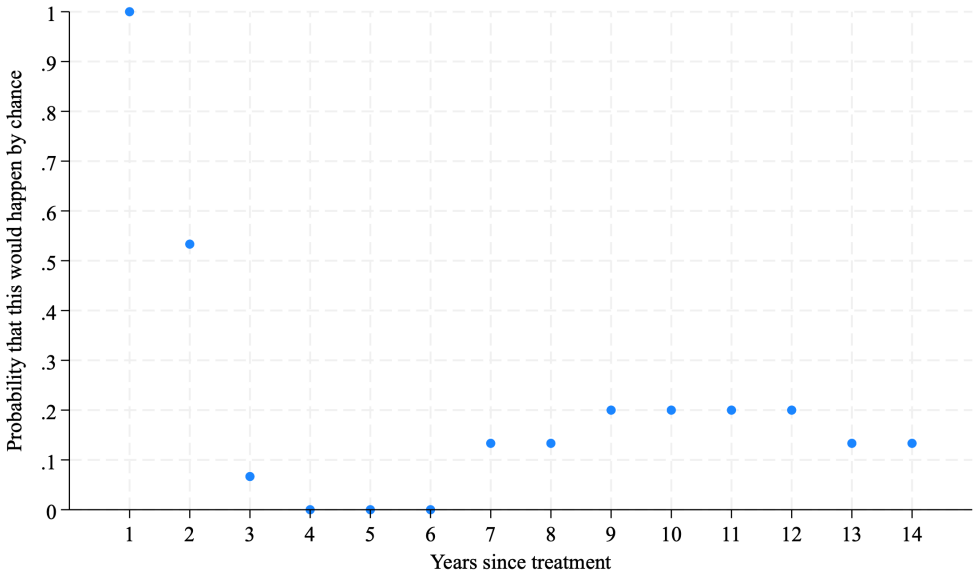


Figure 11: Standardized p-values: Cuban Exports the United States

Notes: Standardized p-values for synthetic control on Cuban exports to the United States. See Figure 10 for main plot.

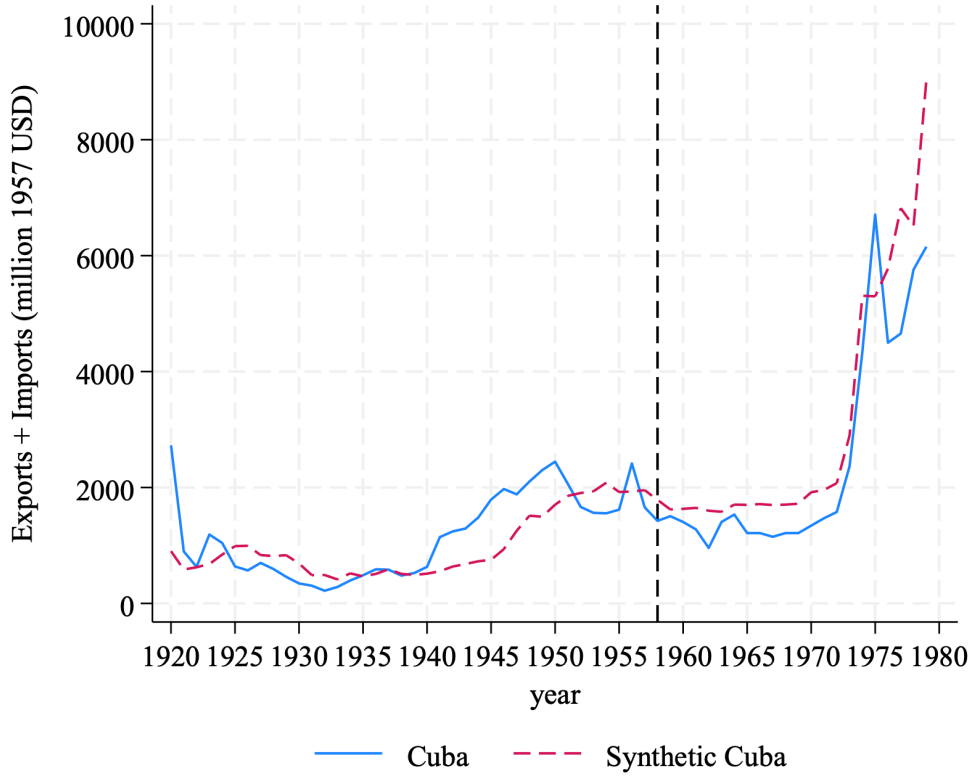


Figure 12: The Effect of the Embargo: Cuban Trade with the World

Notes: This plot shows the effect of the American Embargo on Cuba's trade with the world. Trade data comes from the Montevideo-Oxford Latin America Database (MOxLAD).

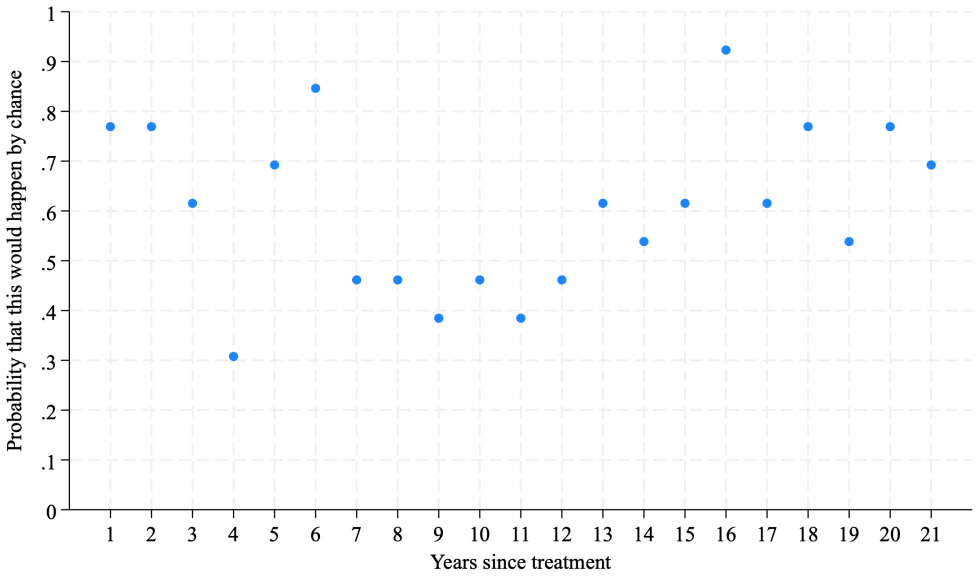


Figure 13: Standardized p-values: Cuban Trade with the World

Notes: Standardized p-values for synthetic control on Cuban trade with the world. See Figure 12 for main plot.

Table 4: Donor Countries and Weights: The Effect of the Embargo

	Country Weights	
Donor Country	Cuba's Trade with the US (Figure 8)	Cuba's Trade with the World (Figure 12)
Argentina	0.169	0.282
Brazil	0.566	0.374
Chile	0	0
Colombia	0	0.052
Costa Rica	0	0
Ecuador	0	0
El Salvador	0	0
Guatemala	0	0
Honduras	0	0
Mexico	0.265	0
Nicaragua	0	0.060
Peru	0	0
Uruguay	0	0.232
RMSPE	118.055	499.117

Note: Percentages may not sum to one due to rounding.

Table 5: Predictor Variable Comparison for Cuba, Synthetic Cuba, and Predictor Weights

Panel A: The Effect of the Embargo on Cuba's Trade with the U.S.				
Variable	Cuba	Synthetic Cuba	Donor Countries	V-Weight
US Trade 1938	362.569	281.798	101.637	0.006
US Trade 1941	627.878	619.384	224.664	0.163
US Trade 1944	941.322	761.041	237.555	0.059
US Trade 1947	1434.113	1417.174	445.254	0.162
US Trade 1950	1055.772	1073.593	345.229	0.271
US Trade 1953	951.837	1016.923	364.590	0.146
US Trade 1956	1042.937	1053.498	384.353	0.052
US Trade 1958	1070.180	1041.853	346.435	0.140
GDP per capita	2463.762	3379.062	3712.410	0.001
Urban Share	57.000	45.120	42.342	0.000
Schooling	3.355	2.560	2.996	0.000
Panel B: The Effect of the Embargo on Cuba's Trade with the World				
Variable	Cuba	Synthetic Cuba	Donor Countries	V-Weight
Trade 1929	458.767	1018.440	589.223	0.141
Trade 1932	218.652	469.303	287.260	0.000
Trade 1935	485.596	442.322	309.173	0.027
Trade 1938	480.230	472.657	297.002	0.000
Trade 1941	1144.235	543.070	314.744	0.042
Trade 1944	1482.273	812.074	428.630	0.000
Trade 1947	1882.018	1552.046	765.426	0.175
Trade 1950	2445.416	1938.319	892.376	0.073
Trade 1953	1562.759	2159.122	1013.420	0.000
Trade 1956	2414.563	1898.534	958.832	0.146
Trade 1957	1658.000	1872.985	916.975	0.000
Trade 1958	1424.592	1746.345	833.412	0.274
GDP per capita	2313.026	4215.889	3375.579	0.000
Urban Share 1950	56.500	53.833	41.833	0.005
Urban Share 1955	57.500	57.632	44.967	0.006
Schooling 1940	3.180	3.033	2.721	0.056
Schooling 1950	3.530	3.827	3.259	0.055

Notes: Panels A and B respectively report the predictor balance and donor weight associated with Figures 8 and 12. Unless a year is specified, values report the pre-treatment mean.

Table 6: Ratio of synthetic GDP per capita over different actual measures of GDP per captia with different estimates of the US Embargo's effect (in 1972)

Data	Estimate (in 1972)	Effect Size ($)	Effect Size (%)	Embargo Effect (as % of total)
- - Synthetic Cuba	$ 4,694			
— Adjusted	$ 2,425	$ - 2,269	-48.33	
— Adjusted minus Soviet Aid	$ 2,608	$ - 2,608	-55.56	
- US Exports Effect ($ 257)	$ 2,343	$ - 2,351	- 50.08	9.85
- US Openness Effect ($184)	$ 2,270	$ - 2,424	-51.64	7.06
- World Openness Effect ($ 80)	$ 2,166	$ - 2,528	-53.86	3.07

Notes: Estimate is the value of each series in 1972 – see Figure 1 for details. Effect size is the difference between each adjusted series and the synthetic control, reported in $ and percentage terms. Embargo Effect (as % of total) is how much of the total effect can be explained by different assumptions of the embargo effect.

Appendix

A A Bibliographical Essay on Cuban Living Standards and National Accounts

A.1 How Rich was Cuba Pre-1959?

Initially considered a "backward Spanish colony" (Bulmer-Thomas, 2012, p. 453), Cuba rapidly became one of the richest Caribbean economies (Coatsworth, 2005) such that by the early 19th century, its average income was probably on par with that of the United States (although it was far more unequal).[43] By 1913, this was no longer the case, as income per head had reached approximately 60% of the level observed in the United States. By 1925, Cuba's income per capita placed it roughly on par with America's poorest states (e.g. Alabama, Mississippi).[44] Nevertheless, this remained higher than in all Latin American countries except Argentina, which stood at 80% (Bulmer-Thomas, 2003, p. 492). By the mid-1950s, this relative position persisted (Bulmer-Thomas, 2003, p. 331). Other development indicators—such as car, television, and radio ownership, infant mortality, life expectancy, and literacy—also placed Cuba near the top, at times rivaling European levels (Ward and Devereux, 2012, p. 115).[45] It was also less agricultural than most Caribbean economies (Bulmer-Thomas, 2012, p. 266) In Table A1 below, we provide a partial list of sources and their proposed estimates of pre-revolutionary living standards. In other words, no one disputes the claim that Cuba was ahead of most of Latin America around the time Castro arrived in power.

There is some uncertainty about how far ahead Cuba was, but all the issues tend to *underestimate* its relative wealth. GDP per capita estimates are often believed to be

[43] However, it was unequal compared to the United States. Compared with other Latin American countries, it was within the norm (Bulmer-Thomas, 2003, p. 336).

[44] This is done using the ratio of per capita personal income in these states as a share of the same figure for the entire United States.

[45] Cuba was also responsible for one quarter of Latin America's capital formation in machinery and equipment in 1920 (Tafunell, 2007). It presented the highest level of per capita investment in machinery between 1890 and 1930 (Tafunell, 2009).

understated due to population counting issues (Santamaría García, 2006, p. 5).[46] Cuban GDP per capita figures were affected by fluctuations in population statistics, particularly due to immigration laws that influenced census counts. Historical income per capita estimates were often understated because official statistics included individuals legally classified as Cuban who may not have been originally accounted for. Additionally, income in sectors less linked to exports is thought to be further underestimated. In other words, Cuba may have been even further ahead before 1959 than commonly appreciated.

Year	Variable	Source	Rank	Out of
1913	Income per head	Bulmer-Thomas (2003)	2nd	9 LA countries
1950	Income per head	Bulmer-Thomas (2003)	3rd	20 LA + C countries
1955	Income per head	Devereux (2021)	5th	20 LA + C countries
1955	Consumption per capita	Devereux (2021)	3rd	20 LA + C countries
1955	Human Development Index	Devereux (2021)	3rd	15 LA + C countries
1953-1958	Income per head	Mesa-Lago (2009)	3rd	20 LA + C countries

Table A1: Economic Rankings of Cuba by Year and Source

The last step is to create an estimate of GDP per capita pre-1957. This is far easier thanks to earlier work by Devereux (Ward and Devereux, 2012). It draws on the Oshima's (1961) nominal consumption estimates for 1953 and their own estimates of relative price levels of Cuba and the United States. The series is extended to 1928 using industrial production index by Pérez-López (1977) and gross industrial output data from Oshima (1961).

However, Cuba was severely affected by the Great Depression, and by 1955 Cuba's was merely 27 percent of the U.S. In those 30 years, Cuban income per capita grew by only 3 percent. It was only by the end of the Second World War that income returned to its 1928 levels. Importantly, Ward and Devereux's estimates have been adopted as the standard GDP series for Cuba in the Maddison database for the 1902-1958 period.

[46] Santamaría García (2006) is a mimeo document; however, the most recent MPD (2023) uses it as one of its sources.

A.2 Quality of National Accounts Post-1959 and Devereux's Adjustments to Cuban GDP

The agreement on Cuba's relative wealth with Latin America before 1959 is extended to the general evolution of living standards up until that point. It suffered heavily from the Depression but rebounded gradually to enjoy steady growth (albeit at a modest rate when compared to the United States) until 1959. In fact, all continuous series generally agree on the evolution of Cuban GDP per capita from the early 1930s to 1959.[47] The differences and disagreements emerge after 1959.

First, it is worth understanding the multiple versions of MPD carefully. The original estimates (for all countries) of the Maddison project "were based on a single modern-day cross-country comparison of relative income levels, for the year 1990, projected forwards and backwards using data on growth of GDP per capita [from National Accounts]" (Bolt et al., 2018, p.2). Thus, by construction, his method correctly captures absolute growth rates that match those in local currencies from national accounts, but it implicitly assumes that changes in purchasing-power parity can be well-approximated by relative inflation rates (Bolt and Van Zanden, 2020).[48] However, it may create distortions that affect cross-country comparison of relative income in the long run if consumption baskets or relative prices change substantially relative to this single-year benchmark (Prados de la Escosura, 2000). In 2018, the MPD decided to rebase the series, providing a new series that relies on the methodology from the Penn World Tables (PWT) (Feenstra et al., 2015) and incorporate price levels of the 2011 ICP round. The trade-offs of these new estimates are discussed at length in Bolt and Van Zanden (2020).

Because the MPD relies on extrapolating from a single benchmark year, it is crucial to understand the initial benchmark estimate for Cuba. For 2010 and 2013, it relies on

[47] Cuba was severely affected by the Great Depression, and by 1955 Cuba's was merely 27% of the United States whereas it had been roughly equal to 45% in 1925. It was only by the end of the Second World War that income returned to its 1928 levels – suggesting that Cuba's Great Depression was from 1929 to 1945. However, the pace of the decline in the 1930s appears debatable. Devereux estimates a steeper drop to 1933 than other series However, the pace of recovery he proposes is similar to that of the other series.

[48] For a greater discussion, see Deaton and Heston (2010) and Inklaar and Rao (2017).

a 1990 benchmark from the original Maddison (2001), where it "was assumed that the average per capita GDP level [...] for Cuba that it was about 15 per cent below the Latin America average" (p. 192). For the 2013 edition, Bolt and Van Zanden (2013) argues that the initial assumption was arbitrary, and aims to correct it using an estimate from Zimbalist and Brundenius (1989) comparing Cuba to six Latin American countries in 1980, which was then extended to 1990 using growth rates at national prices, and then reflated to 1990 Geary-Khamis dollars (for details, see Bolt and Van Zanden, 2013, p.21).

Since the 2018 edition, they rely on an estimate of Cuban GNI at $6,821 reported in the United Nations Human Development Report (henceforth, UN-HDR).[49] They point to the 2016 UN-HDR as their source, but we need to go to the 2015 edition of the UN-HDR to really understand it.[50] In the 2015 edition, the UN-HDR informs the following (Note i, p. 31):

> The 2013 HDI value published in the 2014 Human Development Report was based on miscalculated gross national income per capita in 2011 purchasing power parity dollars, as published in World Bank (2014). A more realistic value, based on the model developed by HDRO and verified and accepted by Cuba's National Statistics Office, is $7,222.

Indeed, in 2014 edition, the UN-HDR had placed Cuba's income at $19,844. But even when we focus on the "corrected" 2015 measure, we could not find any publicly release statistical or methodological appendix from UNDP that explains the "model developed

[49] They reason in favor of this benchmark because in the 2011 ICP round the price level for Cuba was 32.2 percent of the US level, comparable to that of India, which seems implausibly low (Bolt et al., 2018, p. 49). Assuming this price level would substantially overestimate Cuban income level, putting it close to that of Chile, in 2011, at $19,068. The authors choose to consider Cuba a "non-benchmark economy," and use an econometric estimate to reach at the final 2011 benchmark at $6,928. See Bolt et al. (2018, 49-50) for an extended discussion.

[50] The 2016 UN-HDR places Cuban GDP at $7,455 (see Table 1, p. 199). It also informs in a footnote that the estimate is based "on a cross-country regression and the projected growth rate from UNECLAC (2016)." This means that cross-country regression was estimated for 2015 UN-HDR (United Nations, 2015), and extended to 2016 report using growth rates from the 2015 edition of ECLAC's *Preliminary Overview of the Economies of Latin America and the Caribbean* (UNECLAC, 2015, Table VII.1, p.59.). It is worth emphasizing that ECLAC did not itself publish any PPP income level for Cuba – it only provided growth rates and qualitative economic analysis.

by HDRO." Mesa-Lago (2020) also explicitly states that he was unable to find HDRO's methodology. More broadly, he and Vidal (2017) offer severe criticism of estimates of Cuban GDP used in the Human Development Index since the 1992 edition. In short, Cuban GDP estimates in the MPD rely on either an arbitrary assumption that it was 15% below the Latin America average, on a regression-based estimate from Zimbalist and Brundenius (1989), or on another regression-based estimate with no available methodology that cannot be publicly verifiable.

Table A2 reports the main differences affecting Cuba under each edition of the MPD. Except for the original arbitrary estimates by Angus Maddison (Maddison, 2001), Cuba was always report as richer in 1989 than it was just prior to the revolution, in 1959.

Table A2: Sources for Cuban data in MPD, different releases

Metric	Earlier	2010 & 2013	2018	2020 & 2023
1959 level	$ 3,140	$ 2,067	$ 4,255	$ 3,006
1989 level	$ 3,070	$ 2,991	$ 7,268	$ 4,991
Unit	1990 GK	1990 GK	2011 GEKS	2011 GK
Growth (1959-1989)	-2.22%	44.7%	66%	66%
Benchmark Year	1990	1980	2011	2011
Benchmark Source	Maddison (2001)	Zimbalist & Brundenius (1989)	UN-HDR (2016)	UN-HDR (2016)

Notes: GK refers to Geary-Khamis dollars. "Earlier" editions refer to the original work by Angus Maddison. We use the 2001 edition as reference (Maddison, 2001). For 1959 onward, data in all editions comes from the original Maddison estimates, which rely on "various ECLAC sources [1950-1990], 1990 onwards from ECLAC, *Preliminary Overview of the Economies of Latin America* (1998 and 1999 editions)" (Maddison, 2001, p.191). Since 2013, it was extended pre-1950 using the following sources for growth rates: Santamaría-Garcia (2005) (1690-1895); Ward and Devereux (2012) (1902-1958). UN-HDR is the United Nations *Human Development Report*.

More systematically, these discrepancies are also illustrated in Figure A1 below. The updates for 2010 and 2013 indicate no growth from 1959 to the mid-1970s, with GDP per capita by the collapse of the USSR showing a 45% increase from 1959 levels. In contrast, the MPD updates for 2018, 2020, and 2023 suggest a 66% increase, with most of the divergence from earlier estimates occurring after the 1970s. Applying the movements of the Devereux series (which includes Soviet subsidies) to the MPD's 1959 level yields a figure of just 23% – far below the other estimates of 45% and 66%.

What accounts for these differences? Two sets of issues exist. The first set is tied

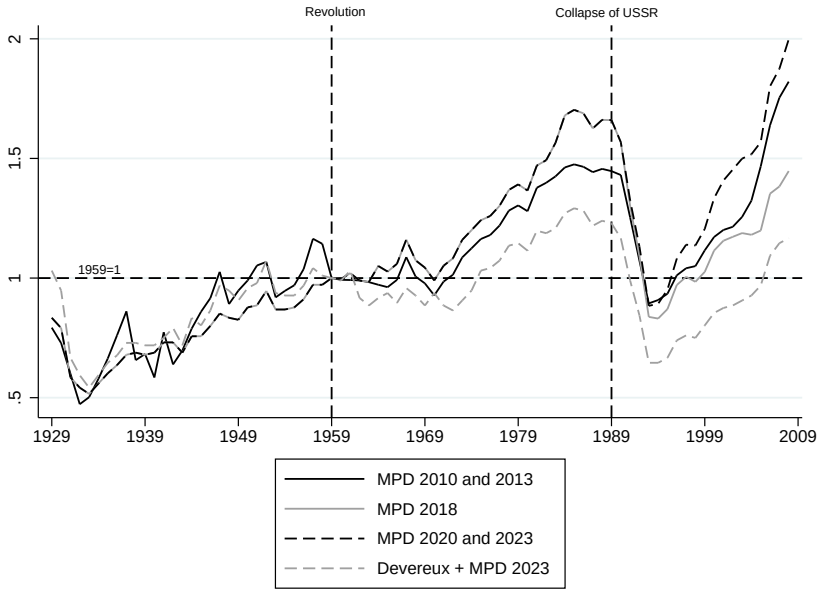


Figure A1: Comparing the Maddison Project Database Updates and the Devereux Modifications (GDP per capita 1959=1), 1929 to 2008

to the nature of dictatorial regimes and it is not a technical issue as much as it is a reliability issue. There is the obvious role of statistical manipulation which is common to dictatorial regimes (Pritchett, 2000; Magee and Doces, 2015; Martinez, 2022; Phan, 2023; Alvarez et al., 2024; Wigley, 2024). Dictatorial regimes are very able to manipulate data that relate to capital accounts and government spending by playing with accounting rules that are difficult to detect. Other types of data, such as trade data for example, are harder to manipulate without being detected. Given the scale of the government and government enterprises in Cuba, the scope for lying is pretty large. The incentives for lying are also quite high since *perceived* good performance can serve to prop up legitimacy (Guriev and Treisman, 2019). As Devereux pointed out, "data are not published when they embarrass the authorities" (p. 9).[51] As a result, there is "a consensus that Cuban indices – industrial production, GDP, the CPI, etc. – must be viewed skeptically as they often exaggerate economic performance" (Devereux, 2021, p. 9).[52]

[51] See also Mesa-Lago (1969), Pérez-López (1991b) for Cuba in particular, Gregory and Harrison (2005) for a similar application to Soviet Russia and Alvarez et al. (2024) for dictatorships in general.

[52] Another assessment of reliability is this one: "Official compilations appear only sporadically, data for some years is non-existent or unreliable, official sources are not always in agreement, and the methodology behind some data series is unclear or changes periodically" (LeoGrande and Thomas, 2002, 326).

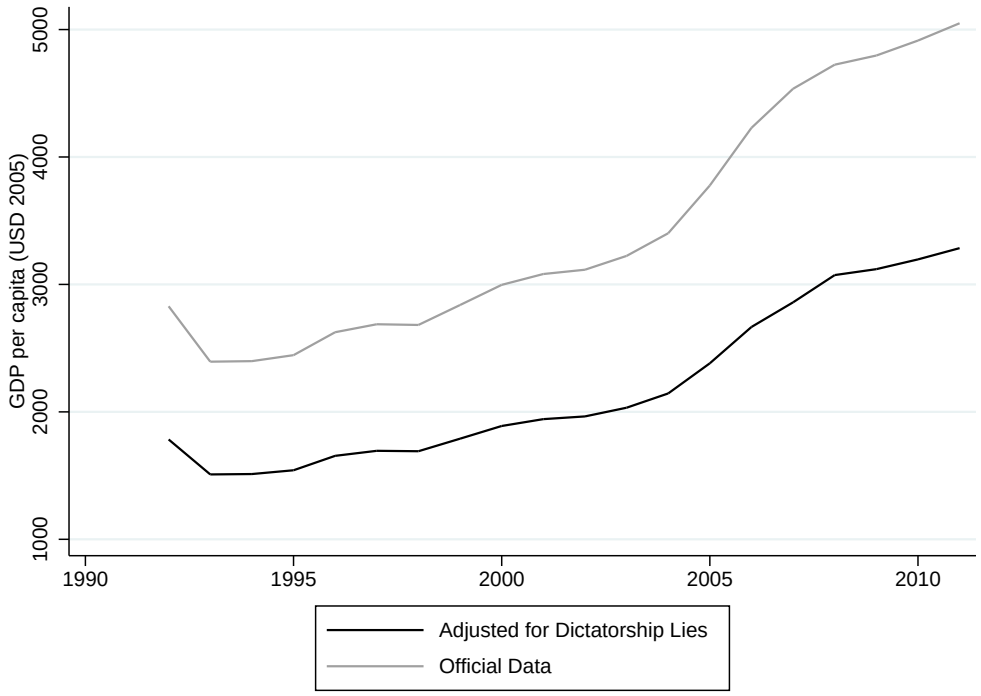


Figure A2: Cuba's GDP per capita corrected for regime-related lies, 1992 to 2011

In recently published work, Martinez (2022) corrected GDP figures for a large number of countries between 1992 and 2013 using artificial nighttime light intensity (henceforth, NTL). NTL is considered a reliable proxy of well-being because it is independently generated via satellite imagery and is thus immune to data manipulation. Moreover, since NTL is artificial and results from human activity, it serves as a proxy for the level of economic development. Using a log-linear regression, Martinez (2022) specifies a model in which the log of GDP is explained by NTL and an interaction term between NTL and regime type. The coefficient associated with this interaction term captures the autocracy gradient of bias in the data. In Figure A2, we present the corrections made by Martinez (2022) for Cuba and compare them with the "official" figures. As shown, the true GDP values are approximately one-third lower than the reported ones—a substantial discrepancy.[53]

The next set of concerns pertains to a series of more technical subsets of issues. The first subset is the meaning of prices under planning and coercion. In a planned economy,

[53]Unfortunately, there are no satellite data pre-1992 and so we cannot extend such measures backwards.

especially under price controls, prices do not accurately reflect consumer valuations. At best, they may approximate the marginal cost to producers, though even this is highly imperfect (Levy, 1990; Vedder and Gallaway, 1991; Higgs, 1992, 1999). This is particularly true for "government outputs". How do we value goods like lighthouses (public goods) and whether it is truly a public good provided efficiently? Valuing government outputs has long been a challenge, dating back to the earliest national accounts (Kuznets, 1945; Forte and Buchanan, 1961; Nordhaus and Tobin, 1972; Spindler, 1982; Boulding, 1993). Under coercion—such as in Cuba—these difficulties are magnified, as coerced output is recorded in economic measurements, while its true costs remain obscured (Geloso and Pender, 2023; Geloso, 2024; Geloso and Reilly, 2024b).[54] Price controls – as those that exist in Cuba – also make it hard to adjust for inflation (Vedder and Gallaway, 1991; Geloso and Pender, 2023; Geloso and Reilly, 2024b).

Another subset relates to the manner of making conversions for purchasing power parities (PPP) to allow comparisons of living standards across countries. For the period since 1950, the Maddison Project Database uses the benchmark years produced by the Penn World Tables 8.0 in combination with historical reconstructions of earlier estimates for the pre-1950 period. The MPD is clear that the benchmarks are used at face value, suggesting that quality issues are treated as something beyond the control of the research team (Bolt and van Zanden, 2024). The problem is that researchers also believe that the post-revolution (i.e., 1959) PPP corrections for Cuba are of low quality. Carmelo Mesa-Lago states that "Cuba did not— and does not—publish the necessary information about goods and services prices, as well as many other elements that are needed to make

[54] Geloso (2024) provides a good example of this using slavery. He points out that slavery is a form of tax on leisure – coercion forcing workers to forego leisure that the offered "compensation" (for lack of a better term). In national accounts, the output produced by slaves and coerced workers will be measured. However, that is *inefficient* overproduction that reduces the ability to use national accounts to speak about the evolution of living standards. This may seem like an extreme case to use as analogy for Cuba. It is not. Human Rights Watch (1999) pointed out that the Castro regime makes great use of prison labor. Convicts include political dissidents. Human Rights Watch also indicates that Cuban authorities track politically suspect behavior in labor files, often leading to job loss for dissidents. With few non-state jobs, financial hardship follows, especially for those lacking remittances or self-employment opportunities under strict regulations. The result is a form of labor market power for the state which can coerce workers. As such, the coercion bias discussed by Geloso (2024) could very well be highly relevant for Cuba's GDP numbers.

the conversion to PPP" (Mesa-Lago, 2002, p. 451). The prevailing belief, consistent with Cuba's status as a dictatorship with strong incentives to manipulate data, is that withholding the relevant information likely conceals a poorer and more sluggishly growing economy.

This problem of converting to PPP is also visible in the work of Jales et al. (2018) who studied the effect of the revolution on GDP per capita using the "official" numbers. They used the Montevideo-Oxford Latin American Economic History Database, which in turn employed purchasing power parity (PPP) adjustments from Zimbalist and Brundenius (1989) and ECLAC (Economic Commission for Latin America and the Caribbean) (Rey and Bértola, 2018). The former derives price estimates directly from official Cuban data which is biased in favor of showing more growth than there truly is (Devereux, 2020; Pérez-López, 1991b). Ergo, their results are also optimistic assessments of the regime because of PPP issues.[55]

The third subset concerns the system of national accounts. Due to the regime change, Cuba transitioned between the United Nations System of National Accounts (SNA) and the Soviet Material Product System (MPS) – two widely different systems of measurement. SNA use market value whereas MPS used material output quantities (e.g., tons of steel) with multiple services being excluded. Under MPS, the physical quantities of output are converted into a monetary amount using administered prices (i.e., those set by the regime with little detail about the reason). The SNA, for its part, uses market prices to measure the valuation of goods and services exchanged in their final stage.[56]

[55] Jales et al. (2018) also use estimates of GDP per capita from the 2013 Maddison Project Database (Bolt and Van Zanden, 2013, 2014), though they do not report them, as the results are similar. This earlier edition of the MPD relied on Zimbalist and Brundenius (1989), which suffers from the same issues as the main series used by Jales et al. (2018). This is why, when we refer to "optimistic assessments," we mean that the true counterfactual, based on the far less problematic pre-1959 data, will remain largely unchanged. Meanwhile, the "actual" data used to measure the gap with the counterfactual will shift depending on one's perspective. If one believes the revolution had positive effects, the revised data will show a smaller gap, implying that Cuba's economic performance was closer to the counterfactual relative to results with the official data. Conversely, if one views the revolution as detrimental, the adjustments will reveal a larger gap, reinforcing the argument that economic outcomes were significantly worse than they would have been without the revolution.

[56] As discussed above, with the case of price controls, one should note equate the market price with the "free market" price. Price controls foil the quality of SNA-based measurements as the rationing, wait lines and risks born by shifting to illicit markets are forms of "prices" that are simply not measurable.

Conversion between the two systems is notoriously difficult (Ivanov, 2009). However, it is not impossible. Russia's transition away from communism included a shift in its accounting system, which has been largely successful, albeit with some qualifications (Voskoboynikov, 2012). The key challenge is that converting figures requires access to underlying data, which was available in Russia. One highly plausible reason is that after the Soviet collapse, the new regime had little interest in manipulating evaluations of Soviet-era economic performance, making data corrections possible. Cuba, however, is a different case – the government continues to withhold key data, making it difficult to convert figures from the period when the country used the Material Product System (MPS).

Taken together, the mixture of data quality and technical measurement issues make it hard to assess exactly how rich Cuba was. Devereux (2021) aims to rectify these errors by providing an alternative measure of GDP per-capita post-1957 that addresses directly or indirectly the aforementioned concerns. He finds that official GDP per-capita measures significantly inflate growth relative to the newly constructed series. To make his adjustments, he uses prices from 1957 to weigh the different physical output indexes. Given that 1957 is a pre-revolution (i.e., pre-communist) year, he equates them to market prices that limit some of the issues with the use of MPS for estimating output. The prices are used to weighted sectoral indices for sugar, industrial crops, food crops, livestock products, forest products, fishing products, manufacturing outputs (for 9 sectors and an additional category that can be considered as miscellaneous), government and services. These indices are constructed using the CIA handbooks which, for some sectors such as agriculture with the Food and Agriculture Organization (FAO), have been crossed-checked by international organizations. When CIA handbooks failed to provide materials, he relied on the work of other scholars such as Brundenius (1984), Pérez-López (1987) and Zimbalist and Brundenius (1989).

In his supplementary materials, Devereux (2021) compares his GDP estimates for the overlapping period (1965–1975) with those of the CIA, Brundenius (1984), Pérez-López

(1987), and Zimbalist and Brundenius (1989). Using 1965 as the base year (100), he finds that GDP reaches 130 by 1975. This contrasts with 114 according to the CIA, 150 for Brundenius (1984), 144 for Pérez-López (1987), and 168 for Zimbalist and Brundenius (1989). In per capita terms, Devereux estimates a 10% increase, compared to a range of -6% to 48% in other sources. The Maddison Project Database (MPD), for its part, reports a 20.9% increase. However, this comparison is somewhat misleading, as 1965 appears to be part of rebound, following a significant economic contraction between 1959 and 1962 or 1963 (depending on the series). This is where key differences emerge. According to Devereux, the decline in GDP was more pronounced in the early years of the revolution, leading to a sharper initial contraction. As a result, when examining the entire 1958–1975 period, the divergence between the MPD and Devereux's estimates becomes more evident. Devereux's estimates suggest a modest 2.06% increase in per capita income, while the MPD, relying on official data, reports a significantly higher growth of 27.8%.

Before proceeding, it is worth noting that Devereux (2021) reports figures exceeding the tentative estimates of the Central Intelligence Agency (CIA), which he includes in his paper. The CIA's estimates are viewed with the same skepticism as the Cuban government's GDP figures, largely due to the perception that the agency had an incentive to portray the regime as a failure.[57] Indeed, the CIA's figures appear somewhat implausible, as they imply a 6% decline in GDP per capita relative between 1965 and 1975—an estimate unmatched by any other source (see notably Herrera (2023) for alternative estimates).[58] However, the notion of deliberate manipulation by the CIA appears to have been dismissed by Pérez-López (2010). The explanation provided is that the CIA attempted to reconcile the MPS and SNA accounting systems by incorporating what the MPS classifies as "non-material" products (e.g., education, public administration). In

[57] As we will discuss below regarding Soviet subsidies, the CIA's estimates are often seen as deliberately inflating the magnitude of Soviet aid while deflating GDP to exaggerate the proportional size of Soviet support.

[58] We cite Herrera (2023) because he relies on difficult-to-access sources that are clearly favorable to the regime, presenting exceptionally high growth rates (see pp. 159, 160). Additionally, he frequently cites outdated sources despite writing at a time when better estimates were available—for instance, referencing the 1995 Maddison estimates, which depicted rapid Cuban growth, even though subsequent revisions in the 2000s significantly downgraded these figures.

doing so, they inadvertently reported a government sector smaller than it actually was. In discussing the different estimates, Pérez-López (2010) mentions the numbers produced by the Cuban government for the "non-material" products and how they differ from those of the CIA. Including the difference between the two eliminates the decline of 6%. Unfortunately, the CIA series is available only to 1975 and does not cover the first years of the regime (1959 to 1965).

Devereux also makes modifications for the post-MPS-abandonment period which includes some years prior to the USSR's final end of subsidies (which prompts the crisis of the early 1990s). He points out that while Cuba shifted to SNA, it prices government services at arbitrary "social valuation" prices rather than at cost as per usual national accounts practices. This is an upward bias. This is consistent with the points made with respect to data manipulation whereby governments fiddle national accounts in the categories they can most easily get away with such as the valuation of government services. Devereux corrects for this by assuming that government services follows the same path as the path of the aggregated value of the non-governmental components (agriculture, manufacturing, construction, wholesale, transport).

Now, it is worth noting that the corrections made by Devereux (2021) still have limitations. Fortunately, we understand the direction of these biases, allowing us to interpret any results based on his series accordingly. The price weights used are from 1957—pre-revolutionary prices. Using early-period prices as a reference for converting quantities into values introduces the Gerschenkron effect, which occurs when fixed price weights fail to account for relative price changes over time, leading to overstated growth.[59] This is why Devereux explicitly states that using 1957 prices "will therefore exaggerate Cuban growth, perhaps considerably" (p. 9). While Devereux's corrections mark a significant

[59]The Gerschenkron effect refers to the systematic overestimation of growth rates when using index numbers. Fixing a base year too far in the past creates bias if structural changes alter relative prices. The term comes from economist Alexander Gerschenkron, who studied Soviet output after the October Revolution of 1917 (Gerschenkron, 1947). Warren Nutter (Nutter, 1962) challenged Soviet industrial growth estimates, arguing that official indices suffered from price distortions and weighting biases, leading to exaggerated claims. While Harrison (2000) has nuanced Nutter's critique, the core argument remains valid.

improvement over existing series, they still represent a trade-off between feasibility and the ideal of perfectly unbiased measurement. As such, the figure of 2.06% mentioned above is overstated by this.

There is also the issue of the measurement of agricultural output. Devereux (2021) assumed that value-added output indices in agriculture were constant. This requires that the ratio between input and gross output to also remain constant over time. However, Cuba increased its use of inputs (fertilizers, pesticides, and machinery) at a pace that was faster than output (Botella-Rodríguez, 2011). As such, this assumption overstates the growth of agricultural value added (Devereux, 2020, p. 5).

The remaining issues noted by Devereux stem from his inability to account for "new sectors" and "new goods" (or quality improvements), which he argues leads to an understatement of growth. However, this concern is primarily relevant for the post-"Special Period" era (i.e., after the collapse of the USSR and the modest economic reforms from 1993 to 2000). The limited liberalization following the Soviet collapse allowed for new goods and sectors to emerge, making traditional GDP measurements less reflective of economic expansion. Consequently, we believe that Devereux's corrections for the post-2000 period may understate actual economic growth. This can be seen when we compare the estimates corrected using NTL data by Martinez (2022) with those of Devereux (2021). This can be seen in Figure X below. From 1992 to 2002, the two series move together and they show a far slower recovery after the USSR's collapse than the official data. After 2002, Devereux appears to be understating growth relative to Martinez (2022). That being said, it is important to notice that even the Martinez (2022) corrections (which take the net sum of all misreporting based on a regression approach) show less growth than with the official data.

Overall, we believe that Devereux's corrections, while indicating slow growth before 2000, likely still overstate actual economic performance. However, for the post-2000 period, his estimates may understate growth due to the impact of Cuba's modest market reforms, which introduced new sectors and goods that are not fully captured in his ad-

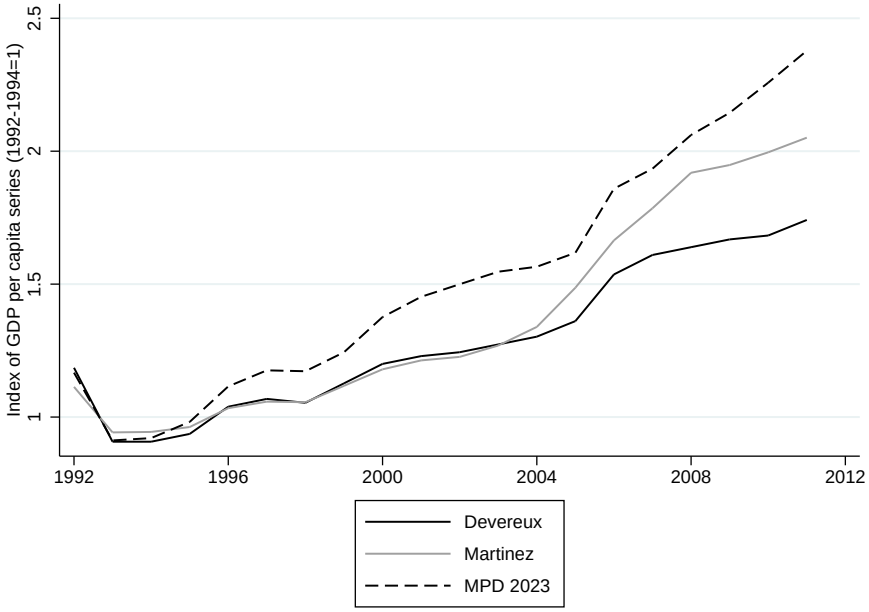


Figure A3: GDP per capita according to different series, 1992 to 2011, indexed to 1992-1994=1

justments. However, that understatement post-2000 is only *relative* to other alternative series which are only available after 1992. Overall, the official series always overstate growth but by a lesser degree post-2000 than pre-2000.

At this point, readers may wonder why we focus on the post-1990 period when our baseline results pertain to the pre-1990 period. The reason for addressing this in the appendix is that, in Appendix F, we replicate our results on the revolution's effects in a different setup. Specifically, we compare Cuba to a donor pool of countries that, like Cuba, were communist before 1989.

All these countries experienced the collapse of the USSR, but Cuba was the only one in our donor pool that did not transition from a planned to a market economy. As a result, Cuba effectively receives a treatment of "not transitioning," while the other countries serve as control units undergoing market reforms. If the revolution had a lasting impact, we should observe its effects relative to this control group of formerly communist economies that embraced market transitions. As such, knowing that the 1990–2000 corrected estimates align and that differences between corrections emerge only after 2000

helps clarify the specification used in Appendix F. This allows us to better contextualize the comparison framework employed in Appendix F, which serves to complement our main results by assessing the impact of the revolution within a different empirical setup.

A.3 The Embargo

The next issue is the embargo by the United States. In Appendix B, we provide the full timeline of the embargo. The briefest summary can be made here: the United States first imposed trade restrictions in 1960 following the Cuban Revolution and the nationalization of U.S. assets by Fidel Castro's government. In 1962, President John F. Kennedy expanded these restrictions into a full embargo, banning nearly all trade between the two nations. Over time, the embargo was codified into law, most notably through the Cuban Democracy Act (1992) and the Helms-Burton Act (1996), which strengthened restrictions and limited third-country trade with Cuba.

The effects of the embargo are difficult to measure because the mechanism is difficult to identify. Gordon (2016) described these difficulties as such:

> *It is difficult to measure with any precision the exact impact of the embargo on the Cuban economy, partly because Cubans, and the Cuban state, have been resourceful at redirecting resources and employed other means of compensating for the losses caused by the embargo. At the same time, Cuba's economy suffers from significant problems aside from the embargo, such as the lack of diversification and inefficiencies in production. Thus, it is difficult to say with precision how much the embargo alone has affected the economy as a whole* (p. 474).

In practice, Gordon's description suggests that the cost lies in the loss of trade and the inefficient redirection of exchange patterns. In other words, shifting from trade with the United States to trade with the rest of the world is not a neutral substitution but rather a costly adjustment. The problem is that there is a further layer of problems that

make it difficult to disentangle things. Most notably, the American embargo restricts foreign companies from trading with Cuba when they relocate production to the U.S. or merge with American firms, as seen when Bayer AG and Pharmacia ceased sales after such transitions (Gordon, 2016, p. 476). This means that the embargo limits the ability to rely on trade with other nations.[60]

Finally, investment flows are also affected. Under normal trade identities, the trade and capital accounts are interconnected, meaning that a reduction in total trade leads to lower capital movement (and, obviously, investment). Thus, the embargo indirectly suppresses investment by restricting Cuba's ability to trade with the rest of the world. However, it also directly limits foreign investment, particularly through the Helms–Burton law, which allows lawsuits against firms using pre-revolution Cuban property. This legal risk has prompted several non-American companies to withdraw from the Cuban market (Spadoni, 2010).

Moreover, there are few reliable estimates of the cost of the embargo. For thirty four years in a row, the UN General Assembly has voted in favor of Cuba's annual resolution condemning the US embargo (LeoGrande, 2015, p. 957). This means that the Cuban government has frequently produced estimates of the cost of the damages. A United Nations press report following a vote on the embargo by the General Assembly states that "six decades of the embargo has cost Cuba trillions of dollars" (United Nations General Assembly, 2023a). In its 2023 brief for the General Assembly resolution, the Cuban government reported an estimated cost of $13 million per day due to the embargo between March 1, 2022, and February 28, 2023 (United Nations General Assembly, 2023b). It claims that growth in 2022 would have been 9% without these restrictions. Over six decades, the total estimated cost is $159 billion, but when adjusted for inflation using gold prices, the figure rises to $1.34 trillion.[61]

In Appendix B, we provide a detailed description of this memo but we can analyze

[60] Cuba's trade is further constrained by regulations barring ships of any nationality from docking at an American port within 180 days of visiting Cuba. For many companies, this restriction makes trade with Cuba commercially unviable.

[61] In 1998, the Cuban government estimated the cumulative cost to 1998 at $67 billion.

it here. The estimate accounts for plausible factors such as lost export revenue, trade reallocation costs, difficulties in securing key inputs, and restricted access to capital markets. However, it also includes questionable assumptions, most notably the claim that all emigration from Cuba was solely due to the embargo (United Nations General Assembly, 2023b, pp. 26/172 and 40/172).[62] It also assumes that all barriers to capital investment (which could promote productivity) stem from the embargo whereas there are multiple examples of industries that have a hard time attracting foreign investment because of the regime's own restrictions (see notably Jones (2019) with respect to modernization in Cuba's cigar industry). It also assigns the entire loss of tourism-related revenues to the embargo (relative to 1959) and it assigned no importance to the nationalization of property and restrictions on investments (Koplan et al., 2001, p. 3-7). Finally, the Cuban government's brief overlooks potential trade adjustments with other nations (e.g. European nations, Canada). In other words, the loss of trade with the United States, in the Cuban government's claims, was not offset by an increase in trade with other countries. This is implausible and clearly incorrect suggesting that the numbers are deliberately being overinflated. In appendix B, we point out that the items for the most obvious mis-assignment of causal importance in the Cuban's government estimates account for 45% of the total. This proportion we believe is a conservative assessment of the extend of the lies of the Cuban government.

However, since these figures are often produced by the Cuban government in link with the General Assembly's repeating resolution, the numbers have been frequently used in peer-reviewed work (Garfield and Santana, 1997). It is even frequently cited in US government publications (Koplan et al., 2001) as a starting point for the conversation. However, other figures are far more modest. One set of estimates, from 1987, was that the cost to the Cuban economy was $431 million (Koplan et al., 2001, p. 2-14) which is less

[62]The figures are highly implausible. In 2019, four years before the $1.34 trillion estimate, the Cuban government reported $933 billion—implying a 43% increase in just four years. Given that 10 to 15% of Cuba's population left the island between 2019 and 2023 (International Organization for Migration, 2025) – a massive exodus – the attribution of emigration costs to the embargo is clearly inflating the overall estimate.

than 1.7% of GDP for that year. And this was estimated using only imports into Cuba from the United States. Some of that amount is bound would have been compensated for by imports from other countries. However, the tightening of the embargo enacted in the 1990s appear to have generated larger costs. The United States International Trade Commission (USITC) attempted to create a trade gravity model to simulate the alternative size of the Cuban economy without an embargo. The USITC estimated that in the absence of sanctions, US exports to Cuba would have between $658 and $1 billion per year between 1996 and 1998 – which represented between 17% and 27% of Cuban imports from the world (Koplan et al., 2001, p. 2-19). However, once trade diversion is accounted for, the USITC concludes that "the overall impact on the Cuban economy" from removing sanctions would "most likely be minimal" (Koplan et al., 2001, p. 3-36). Accounting for foreign exchange flows and investments, barely increases the effect on the Cuban economy (Koplan et al., 2001, p. 3-36). However, the USITC appears to be a bit too dismissive – the effects it finds for 1992-1996 are slightly above 1% of GDP – a non-trivial number. Nevertheless, these estimates are probably overstatement because the gravity model they designed does not appear to include parameters that speak to policy restrictions on foreign investments in Cuba (Koplan et al., 2001, Appendix F). In other words, the USITC assumes that Cuba is like a market economy that is hampered only by the American embargo. This, again, militates in favor of overstatement of the effects.

Finally, there is the challenge of integrating trade-related effects of the embargo into GDP-based estimates of the revolution's impact to isolate one from the other. Since both shocks occurred almost simultaneously, disentangling their individual effects on GDP is inherently difficult. Ideally, a difference in timing would allow to separate the two effects (revolution and embargo). However, this is not possible. This is why some researchers, such as Jales et al. (2018), turn to trade statistics as an alternative indicator. However, as we explain in the main article, linking counterfactual trade statistics to GDP requires the flawed assumption that accounting identities equate to economic identities. Simply

subtracting a counterfactual difference in export revenues from GDP would misrepresent the embargo's effects since changes in trade balance are offset by changes in capital account. The true effect requires a mechanism whereby fewer exports meant fewer future savings to fund investments and fewer imports meant a lesser present ability to acquire foreign capital to make investments. In other words, the true impact of the embargo lies in how trade redirection altered consumer and producer choices, forcing them toward less efficient alternatives than without the embargo (Irwin, 2005).[63] This is what we explain in the main article.

A.4 Soviet Subsidies

The last remaining issue is that of the Soviet subsidies. Calling them subsidies is somewhat misleading because a subsidy entails a form of direct transfer in cash. The Soviet help was meant to subsidize Cuba but it was a transfer that had certain unique features tied to "how" the transfer was made.

The most important element of Soviet aid was the purchase of sugar from Cuba at above world-prices. During 1960, Castro signed a trade deal with the USSR in which sugar would be purchased at world prices (Central Intelligence Agency, 1964, p. 1). However, apparently in response to the Bay of Pigs fiasco, the USSR agreed to pay a fixed price above world markets. From 1961 to 1962, the premium over world prices was 25% (Central Intelligence Agency, 1964, p. 1). This was further increased in 1963 with the price being fixed until the 1970 at roughly twice the world price (Central Intelligence Agency, 1964, p. 1). The premium was fixed with the idea in mind that the fixed prices would remain above the world price until the 1970s. The gap between the fixed price and the world price (assumed to be the market price) only increased from then until the Soviet collapse: from twice the world price to between eight-to-eleven times by the early 1980s (Pérez-López, 1988; Central Intelligence Agency, 1989). For nickel, the increase was

[63] Irwin (2005) is a good template for understanding this. His study is of the 1807-08 Jeffersonian embargo on trade that caused major disruptions to the American economy. The mechanics by which he estimates the costs to Americans is essentially what we are summarizing here.

not as pronounced but the fixed price did reach twice that of the world price (Central Intelligence Agency, 1989, p. 2).

As one will notice, most of the figures cited above are drawn from documents produced by the Central Intelligence Agency. This is not a trivial point—it was a recurring issue in debates over the magnitude of the subsidies (Radell, 1983; Zimbalist and Eckstein, 1987; Zimbalist and Brundenius, 1989; Pollitt, 2004; Pérez-López, 1991a, 1989). Andrew Zimbalist and his coauthors were the most critical of the estimates. They pointed out that the CIA's estimates were based on a hypothetical peso/dollar exchange rate, used an inappropriate indicator of world sugar prices, and assumed that the quality, assortment, and prices of Soviet goods (e.g., oil) sold to Cuba were equivalent to those on the world market. In other words, the exchange rate likely overstated the value of the subsidies and failed to account for the possibility that the Soviets inflated the prices of certain goods—holding quality constant—relative to world market prices. Pérez-López (1989) underlined some similar concerns as Zimbalist but relied on a range of possible values using different sugar price references.[64]

However, Zimbalist slightly overstates his case. The CIA eventually released revised estimates that showed lower levels of economic assistance than previously reported, particularly in the late 1980s (Central Intelligence Agency, 1989, p. 3). These revisions addressed some of the smaller issues raised by Zimbalist—most notably the use of spot prices for sugar in valuing payments to Cuba. As a result, the revised figures aligned more closely with Zimbalist's estimates. As such, by the late 1980s, the estimates of multiple sources are not dramatically different.

To produce his estimates of Soviet subsidies, Devereux (2021) (in his supplemental materials) relied on the revised CIA figures mentioned earlier. However, unlike previous studies, Devereux emphasizes that Soviet aid was not the entirety of external assistance—10% to 15% came from other planned economies. He incorporates these additional

[64] Pérez-López (1989) seems skeptical of one of the points made by Zimbalist by pointing out that Cuba re-exported (thus earning foreign exchange) significant quantities of oil it bought from the USSR (p. 1643). Doing so indicates that the Russians must have sold at a price below world prices.

sources and addresses the exchange rate issue by deflating aid using the UN Trade and Development (UNCTAD) import price index for Cuba, then expressing the figures as a share of Cuban GDP. As a result, Devereux contends that the only remaining issue from Zimbalist's criticisms is the valuation of Soviet goods relative to world market prices and quality.

However, he is likely too conservative in his assessment, as his estimates still understate total aid. Notably, they appear to exclude some lesser-known transfers, such as the premium paid for Cuban citrus exports, which the CIA estimated at $50 million (Central Intelligence Agency, 1989, p. 3). The Soviets also provided military aid that account for roughly ten percent of economic aid. While this benefits Cuba by allowing it to economize on their own military spending, it accounted for approximately 1% of Cuban GDP and as such do not meaningfully alter our results. Because of both issues, Devereux (2021) slightly underestimates the full extent of Soviet support. Correcting for the "net" transfer would cancel out these sources of underestimation which means that we believe the existing series of Devereux can be taken as a reliable indicator of the degree of Soviet support. Figure A4 illustrates Devereux's resulting series for aid.

Figure A4: Soviet Aid as Share of GDP

B The American Embargo and Cuban Responses

Here, we provide a timeline of the American Embargo, with information from LeoGrande (2015).

1960. Eisenhower initiates sanctions. *July*: President Dwight D. Eisenhower cancels Cuba's sugar quota, the first major economic sanction against Cuba, in retaliation for the nationalization of U.S. refineries (p. 940); *October*: Eisenhower imposes an embargo on exports to Cuba, excluding food and medicine (p. 941).

1962. Kennedy expands embargo. *February*: President John F. Kennedy implements a full trade embargo under the Foreign Assistance Act, prohibiting all imports and exports (p. 942); **1963**: Kennedy further expands sanctions, imposing a comprehensive embargo on all transactions with Cuba under the Trading with the Enemy Act (p. 942).

1964. Johnson seeks multilateral embargo. *July*: President Lyndon B. Johnson secures mandatory economic and diplomatic sanctions against Cuba through the Organization of American States (OAS), isolating Cuba in Latin America (p. 942).

1975. President Gerald Ford allows subsidiaries of U.S. companies in third countries

to trade with Cuba, easing the embargo (p. 944).

1977. Carter attempts normalization. President Jimmy Carter lifts the ban on travel to Cuba and Cuban American remittances but does not end the trade embargo (p. 944-945).

1982. Reagan tightens sanctions. *April 1982*: President Ronald Reagan reinstates the travel ban and adds Cuba to the list of state sponsors of terrorism (p. 945); **1986**: Reagan further restricts remittances and bans the import of Cuban nickel (p. 946).

1992. Bush enacts Cuban Democracy Act. *October*: President George H.W. Bush signs the Cuban Democracy Act (CDA), which restricts trade between Cuba and U.S. subsidiaries abroad and penalizes foreign businesses engaging with Cuba (p. 946-947).

1996. Clinton signs Helms-Burton Act. *March 1996*: President Bill Clinton signs the Helms-Burton Act, which strengthens the embargo and allows U.S. citizens to sue foreign companies for "trafficking" in confiscated Cuban property (p. 947-948); **1999**: Clinton eases travel restrictions, allowing more cultural and educational exchanges (p. 948).

2004. President George W. Bush tightens travel restrictions and limits the remittances Cuban Americans can send to their families (p. 949).

2014. Obama begins normalization. *December*: President Barack Obama announces the normalization of relations with Cuba, aiming to end the embargo (p. 939); **2015**: The U.S. embassy in Havana reopens, and travel and financial restrictions are eased (p. 939-940).

B.1 Cuba's Report to the United Nations on the Embargo

In December 1996, following the enactment of the Helms-Burton Act by US Congress,[65] the Cuban government approved Law nº 80, of "Reaffirmation of the Cuban Dignity

[65]This was a bill sponsored by Senators Jesse Helms (R-NC) and Dan Burton (R-IN), which formally became the Cuban Liberty and Democratic Solidarity Act. The act allows U.S. citizens to sue foreign companies for "trafficking" in property expropriated by the Cuban government, in an attempt to deter foreign investors (LeoGrande, 2015, 948). It received strong criticisms from the international community, and legislative reprisals from Canada and the EU, which led to a formal complaint against the United States at the World Trade Organization (Early, 2015, 185). See also Haney and Vanderbush (2005, 113).

and Sovereignty" (*Ley de Reafirmación de la Dignidad y Soberanía Cubana*). This law established (art. 11) that the Cuban government would maintain an updated report on the damages caused by the embargo. This information is used to prepare national reports submitted to international bodies, such as the United Nations General Assembly, and to support claims for economic reparations. For thirty four years in a row, the UN General Assembly has voted in favor of Cuba's annual resolution condemning the US embargo (LeoGrande, 2015, 957).

Cuba's Decree No. 290 of 2012, enacted by its Council of Ministers, establishes the official procedures and guidelines for documenting and reporting the economic such damages. The main purpose of the decree is to provide a standardized, detailed, and verifiable framework for quantifying the supposedly wide-ranging impacts of the embargo on the Cuban economy and population.

1. Lost export revenue: (a) Income lost due to denied access to U.S. markets; (b) Restrictions on transactions with subsidiaries of U.S. companies; (c) Obstacles created by extraterritorial U.S. laws; (d) Trade disruptions with companies in third countries influenced by U.S. sanctions.

2. Trade reallocation costs: (a) Increased transportation and logistics expenses due to longer shipping routes; (b) Additional costs from intermediary involvement; (c) Higher freight and insurance rates; (d) Costs related to transshipment, storage, and handling of goods restricted by embargo measures.

3. Production and service disruptions: (a) Losses from delays or inability to procure spare parts, raw materials, or essential goods; (b) Value of unproduced goods or unprovided services caused by these disruptions.

4. Monetary and financial restrictions: (a) Inability to use U.S. dollars in financial transactions; (b) Exchange rate losses from using alternative currencies; (c) Higher credit interest rates due to restricted access to international financial systems; (d) Seizures of funds denominated in U.S. dollars; (e) Additional banking fees and costs tied to sanctions.

5. Population impacts: (a) Unpaid royalties or compensation for artistic and intel-

lectual work; (b) Blocked financial transfers or inheritances; (c) Constraints on access to universal rights and services.

6. Technological access limitations: (a) Economic losses from being unable to access advanced U.S. technologies; (b) Reduced efficiency, increased resource consumption, and lower competitiveness compared to what could have been achieved with access to those technologies.

7. Emigration and talent loss: (a) Economic and developmental impacts of professionals and technicians leaving the country due to incentives or pressures related to the embargo; (b) Reporting of unfilled positions, delayed projects, and economic losses due to emigration.

Each ministry or organization is responsible for ensuring the accuracy of the information submitted. The decree requires that all data collected be accurate, auditable, and compliant with current legislation. Specific methodologies are outlined for calculating damages. For example, excess inventory resulting from trade disruptions is valued using prevailing international interest rates applied to immobilized goods. Similarly, trade reallocation costs are calculated by comparing pricing for goods in alternative markets, factoring in logistics and intermediary fees. The decree also includes provisions for exemptions, such as data that could compromise national security, specifically for the Ministries of the Revolutionary Armed Forces and the Interior. All collected data must adhere to principles of truthfulness, timeliness, and compliance with legislation. On paper, it reads as a perfectly-designed and reliable methodology. In practice, however, it is hard to trust these numbers. For instance, the majority of these transactions are recorded and assigned directly in dollars without having any purchasing power parity, as the Cuban peso is not traded in the international markets and thus its value outside of Cuba is zero.

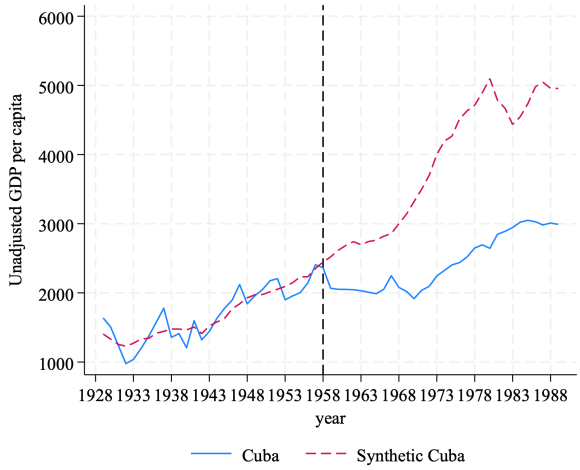
Finally, as we indicated in Appendix A, many of the assumptions are designed to generate larger numbers. All "emigration and talent loss" are assumed to be from the embargo. In its 1998 estimates of the cost (Koplan et al., 2001, p. 3-35), this is 3.8% of cumulative cost of the embargo. Similarly, it assumes that the service disruptions

resulting from input scarcity are also entirely due to the embargo. The disruptions are 14.3% of the cumulative cost. It also assumes that the nationalization of hotels, bars, and restaurants (which occurred in the early 1960s) had no effect on tourism. The decline of tourism from 250,000 in 1958 to less than 50,000 in 1976 is assigned entirely to the embargo. This accounts for a further 26.7% of the embargo's estimated costs by the Cuban government. These three sources of heroic assumptions thus account for 45% of the estimated cost. It is thus fair to say that the Cuban's government is probably an extreme over-inflation of the embargo's cost.

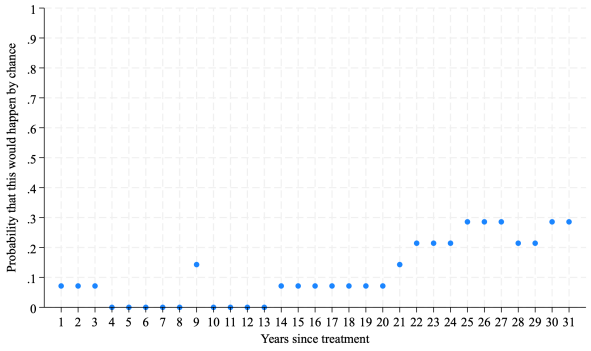
C Alternative GDP Data (MPD 2013)

As a robustness check, we use the Maddison Project Database (MPD) from the 2013 edition. Keen readers will notice that the 2023 and 2020 editions, when indexed to 1959 as reference, evolve the same until 1989 (see Figure A1 in Appendix A). Critically, different versions of the MPD may affect our results because they alter Cuba's own GDP per capita level, because they alter the GDP per capita of other countries of our donor pool, or both. Here, we show that our results are robust to different benchmark methodologies used by MPD over its different editions – see section A.2 in Appendix A.

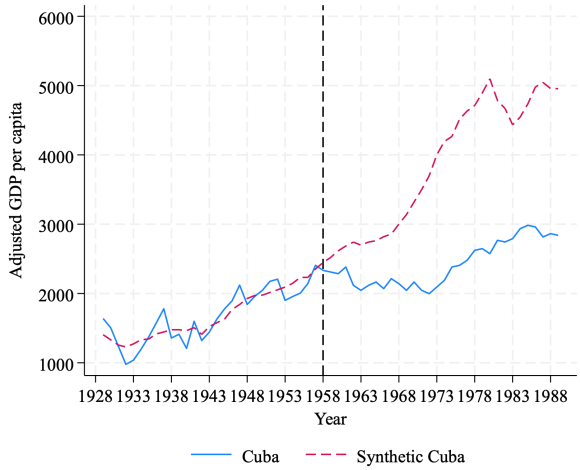
In replicating our results using the 2013 MPD data, we use the same specification as in the main results. There are two key differences, though. First, annual data for Cuba starts only in 1929. Second, Bolivia is dropped from the donor pool because in this version of MPD its data is only available from 1945 onward. The data for Cuba is also somewhat more volatile in the pre-treatment period. Even with these caveats, our synthetic counterfactual closely tracks Cuba over the pre-treatment period and our results are largely unchanged.



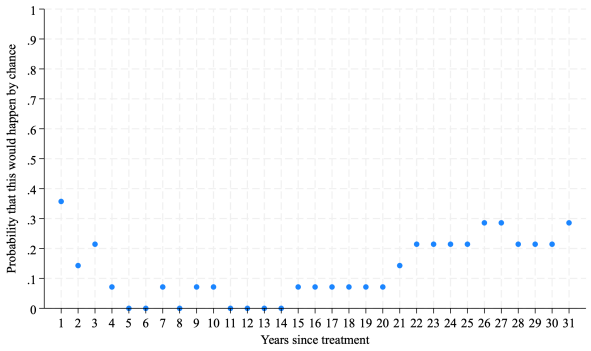
(a) Raw GDP per capita from 2013 MPD



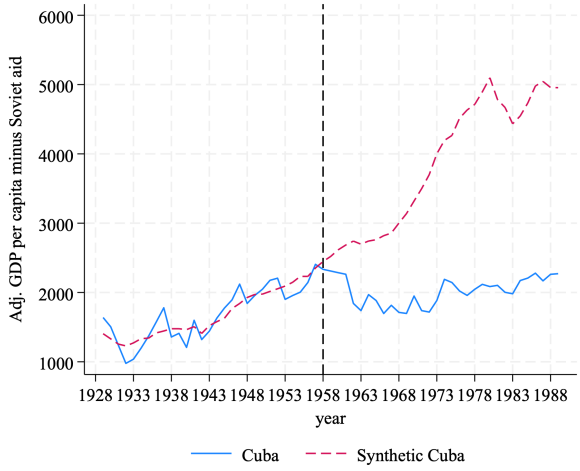
(b) Standardized p-values: Raw GDP per capita



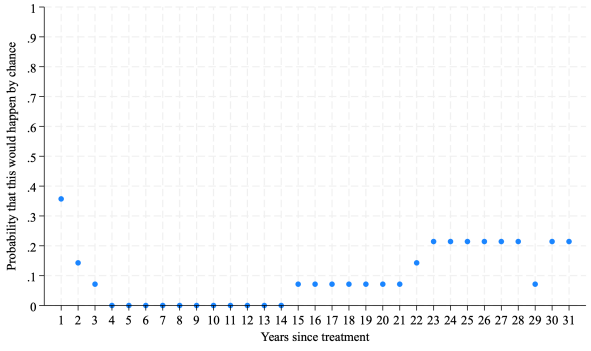
(c) Adjusted GDP per capita



(d) Standardized p-values: Adjusted GDP



(e) Adjusted GDP minus Soviet Aid



(f) Standard. p-values: Adj. GDP - Soviet aid

Figure C1: Causal Effects of the Revolution and Standardized p-values

Notes: All figures measured in 2011 Geary-Khamis dollars. Panels (c)-(d) adjust Cuba GDP 1957 onwards using Devereux (2021); Panels (e)-(f) also deduct Soviet and Eastern Bloc aid, retrieved from Devereux (2020).

Table C1: Donor Countries and Weights: Main Results

	Country Weights		
Donor Country	Unadjusted GDP per capita (Figure C1(a))	Adjusted GDP per capita (Figure C1(c))	Adjusted GDP per capita - Soviet aid (Figure C1(e))
Argentina	0.043	0.043	0.043
Brazil	0.792	0.792	0.792
Chile	0	0	0
Colombia	0	0	0
Costa Rica	0	0	0
Ecuador	0	0	0
El Salvador	0	0	0
Guatemala	0	0	0
Honduras	0.129	0.129	0.129
Mexico	0	0	0
Nicaragua	0	0	0
Peru	0	0	0
Uruguay	0	0	0
Venezuela	0.036	0.036	0.036
RMSPE	162.119	162.681	162.681

Note: Percentages may not sum to one due to rounding. Donors are identical because our adjustment only affects 1958 in the pre-treatment period, and the Soviet aid adjustments just affect the post-treatment period.

Table C2: Predictor Variable Comparison for Cuba, Synthetic Cuba, and Predictor Weights

Panel A: Unadjusted GDP per capita - Figure 2				
Variable	Cuba	Synthetic Cuba	Donor Countries	V-Weight
Urban Share	56.985	37.740	42.393	0.001
Schooling	3.120	2.168	2.544	0.001
GDP per capita 1935 (2013)	1371.239	1341.509	1950.930	0.037
GDP per capita 1940 (2013)	1208.060	1463.986	2233.490	0.040
GDP per capita 1947 (2013)	2120.535	1841.177	2635.491	0.067
GDP per capita 1950 (2013)	2046.225	1976.487	2810.602	0.163
GDP per capita 1953 (2013)	1900.373	2092.413	3016.444	0.074
GDP per capita 1956 (2013)	2144.500	2232.354	3213.842	0.295
GDP per capita 1957 (2013)	2406.354	2353.224	3357.211	0.322
Panel B: Adjusted GDP per capita - Figure 4				
Variable	Cuba	Synthetic Cuba	Donor Countries	V-Weight
GDP per capita (1935)	1371.239	1341.509	1950.930	0.037
GDP per capita (1940)	1208.060	1463.986	2233.490	0.040
GDP per capita (1947)	2120.535	1841.177	2635.491	0.067
GDP per capita (1950)	2046.225	1976.487	2810.602	0.163
GDP per capita (1953)	1900.373	2092.413	3016.444	0.074
GDP per capita (1956)	2144.500	2232.354	3213.842	0.296
GDP per capita (1957)	2406.354	2353.224	3357.211	0.321
Urban Share	56.985	37.740	42.393	0.001
Schooling	3.120	2.168	2.544	0.001
Panel C: Adjusted GDP per capita minus Soviet aid - Figure 6				
Variable	Cuba	Synthetic Cuba	Donor Countries	V-Weight
GDP per capita (1935)	1371.239	1341.509	1950.930	0.037
GDP per capita (1940)	1208.060	1463.986	2233.490	0.040
GDP per capita (1947)	2120.535	1841.177	2635.491	0.067
GDP per capita (1950)	2046.225	1976.487	2810.602	0.163
GDP per capita (1953)	1900.373	2092.413	3016.444	0.074
GDP per capita (1956)	2144.500	2232.354	3213.842	0.296
GDP per capita (1957)	2406.354	2353.224	3357.211	0.321
Urban Share	56.985	37.740	42.393	0.001
Schooling	3.120	2.168	2.544	0.001

Notes: The predictor balance for Figures C1(c), and C1(e) are identical because the Soviet aid adjustment only affects the post-treatment period. Unless a year is specified, values report the pre-treatment mean.

D Alternative Specifications and Donor Pools

Here we replicate our results with different specification and donor pools. We aim to show that our results do not strictly rely on the donor pool of Latin American countries that we choose in our main results.

D.1 Specification Test

We begin by addressing a key concern in synthetic control applications: the potential for researcher discretion in selecting donor units and matching variables, which may lead to specification search (Ferman et al., 2020). To mitigate this issue, we implement the test proposed by Ferman et al. (2020), which relies solely on the full set of pre-treatment lags of the outcome variable, excluding other predictors (covariates). Including all lags renders covariates asymptotically irrelevant, thereby minimizing bias from specification choices.[66] The only noticeable different is that under this specification, the unadjusted GDP series for Cuba eventually catches up with the counterfactual, but more than 20 years after the treatment.

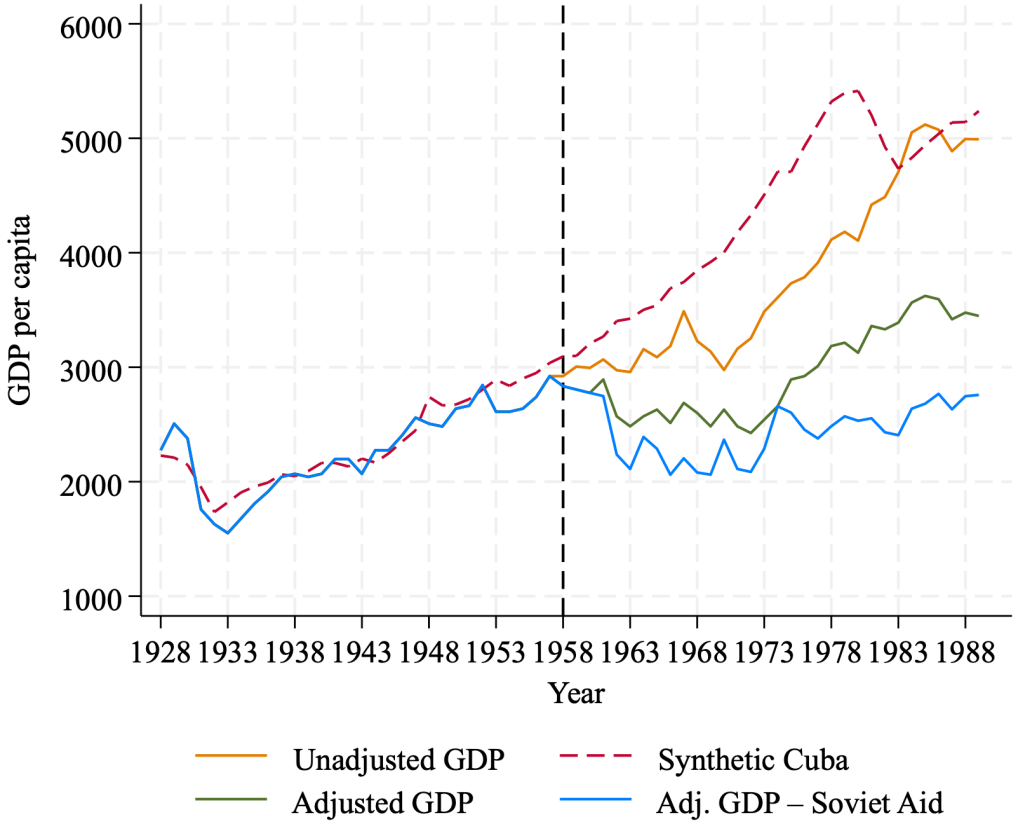


Figure D1: The Effect of the Revolution and Embargo

Notes: This plot shows the combined effect of the revolution and embargo, measured in 2011 Geary-Khamis dollars. Each dashed gray line represents one of the 16 potential counterfactuals estimated by dropping one donor at a time. The unadjusted series simply the 2023 MPD GDP per capita. The adjusted series corrects MPD 1957 onward using Devereux (2021), and the blue series also deduct Soviet and Eastern Bloc aid, retrieved from Devereux (2020).

[66] For related discussions, see Kaul et al. (2015), Botosaru and Ferman (2019), and Ferman and Pinto (2021).

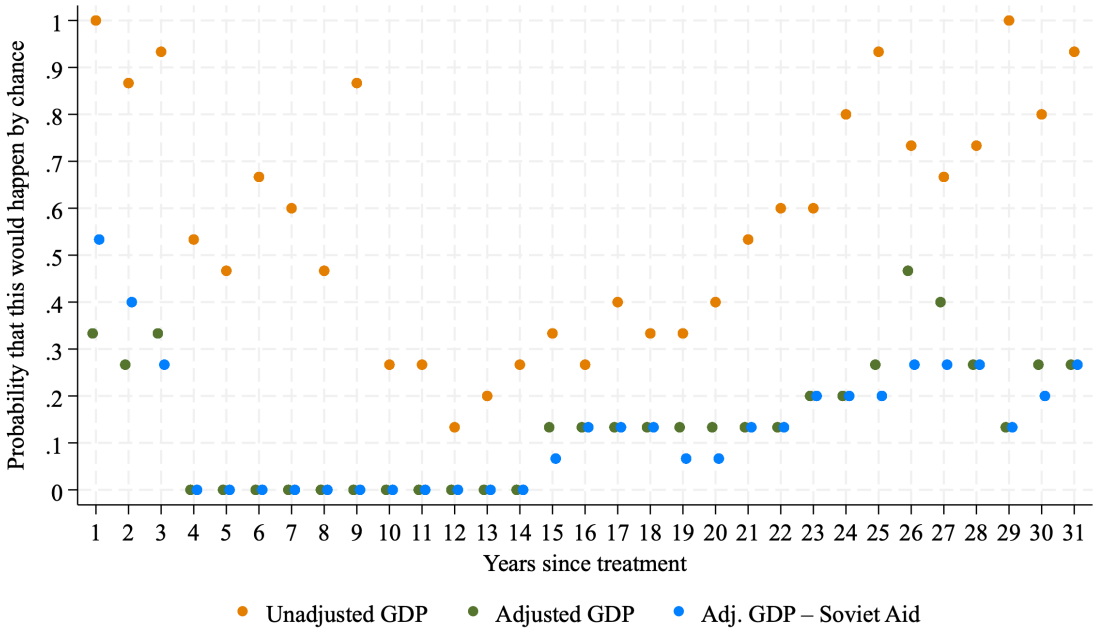
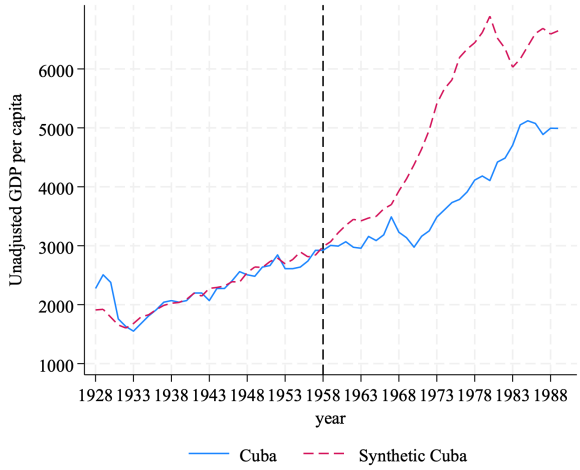


Figure D2: Distribution of Standardized p-values

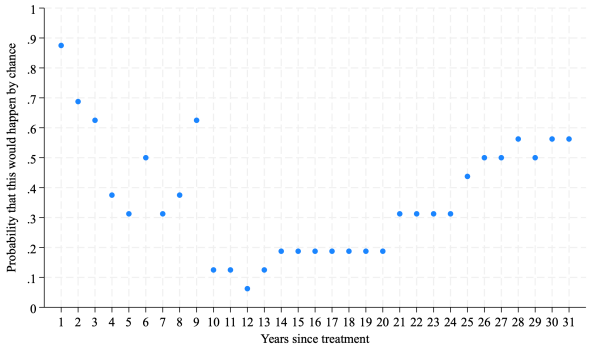
Notes: This figure plots the standardized p-values associated with the each estimated effect in Figure D1, color-coded to match each series. Whenever a single color appears, the p-values for all series are the same.

D.2 Including Puerto Rico

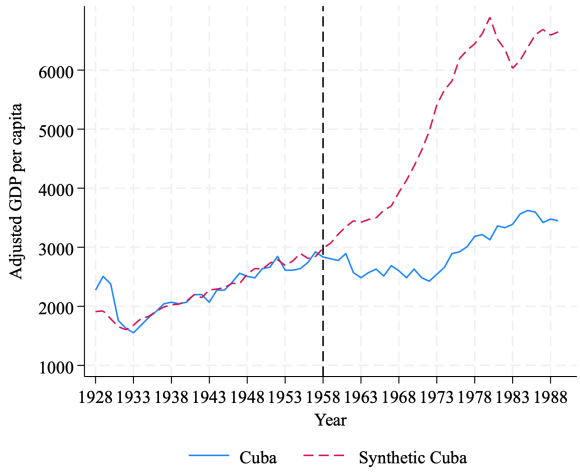
Here, we include Puerto Rico in the donor pool. Although a great potential candidate, we do not have data on schooling for Puerto Rico. Hence, we chose to omit it from the main sample to increase the number of predictor variables. In any case, our results here are unchanged in magnitude, but with marginally larger p-values. The reason is that Puerto Rico's growth since the 1950s is unmatched. Thus, the effect of the revolution becomes the second largest relative to the placebo effects (it is the largest in our base sample). Under two-sided p-values, Puerto Rico's placebo effect outpaces the effect of the revolution, although in the opposite direction. Still, the effect of the Cuban revolution persists as the largest *decline* in living standards in this era.



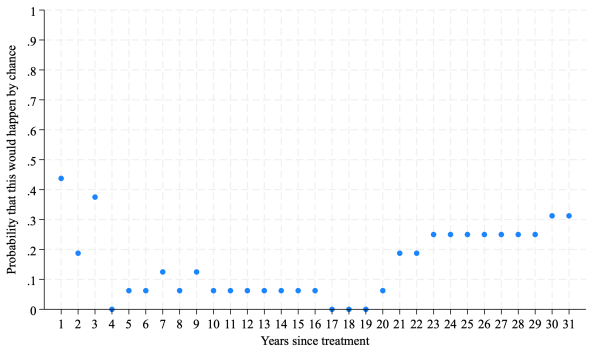
(a) Raw GDP per capita from 2023 MPD



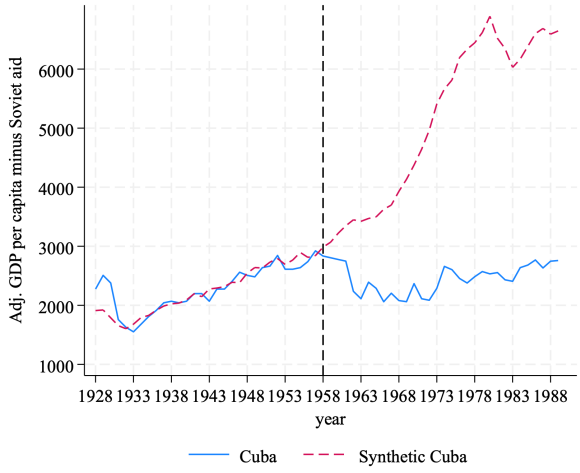
(b) Standardized p-values: Raw GDP per capita



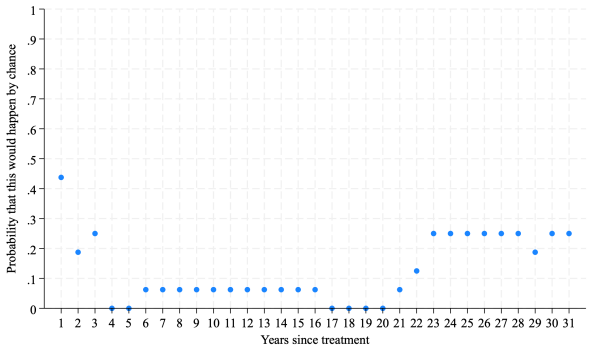
(c) Adjusted GDP per capita



(d) Standardized p-values: Adjusted GDP



(e) Adjusted GDP minus Soviet Aid



(f) Standard. p-values: Adj. GDP - Soviet Aid

Figure D3: Causal Effects of the Revolution and Standardized p-values

Notes: All figures measured in 2011 Geary-Khamis dollars. Panels (c)-(d) adjust Cuba GDP 1957 onwards using Devereux (2021); Panels (e)-(f) also deduct Soviet and Eastern Bloc aid, retrieved from Devereux (2020). Pre-1957 data for Puerto Rico is retrieved from Devereux (2019).

Table D1: Donor Countries and Weights:
Including Puerto Rico

	Country Weights		
Donor Country	Unadjusted GDP per capita (Figure D1(a))	Adjusted GDP per capita (Figure D1(c))	Adjusted GDP per capita - Soviet aid (Figure D1(e))
Argentina	0	0	0
Bolivia	0.190	0.190	0.190
Brazil	0.223	0.224	0.224
Chile	0.079	0.079	0.079
Colombia	0	0	0
Costa Rica	0	0	0
Ecuador	0	0	0
El Salvador	0.359	0.358	0.358
Guatemala	0	0	0
Honduras	0.149	0.148	0.148
Mexico	0	0	0
Nicaragua	0	0	0
Peru	0	0	0
Puerto Rico	0	0	0
Uruguay	0	0	0
RMSPE	155.770	158.351	158.351

Note: Percentages may not sum to one due to rounding. Donors for Figures D3(b) and D3(e) are identical because the Soviet aid adjustment only affects the post-treatment period.

Table D2: Predictor Variable Comparison for Cuba, Synthetic Cuba, and Predictor Weights

Panel A: Unadjusted GDP per capita - Figure D3(a)				
Variable	Cuba	Synthetic Cuba	Donor Countries	V-Weight
Urban Share	56.985	37.828	42.338	0.000
GDP per capita (1935)	1809	1828.499	2831.749	0.047
GDP per capita (1940)	2069	2090.214	3236.639	0.028
GDP per capita (1947)	2560	2384.105	3636.430	0.032
GDP per capita (1950)	2638	2631.784	4061.100	0.160
GDP per capita (1953)	2611	2691.992	4394.901	0.050
GDP per capita (1956)	2740	2812.055	4670.663	0.426
GDP per capita (1957)	2922	2842.285	4830.875	0.257
Panel B: Adjusted GDP per capita - Figure D3(c)				
Variable	Cuba	Synthetic Cuba	Donor Countries	V-Weight
Urban Share	56.985	37.828	42.338	0.000
Adj. GDP per capita (1935)	1809	1828.499	2831.749	0.047
Adj. GDP per capita (1940)	2069	2090.214	3236.639	0.028
Adj. GDP per capita (1947)	2560	2384.105	3636.430	0.032
Adj. GDP per capita (1950)	2638	2631.784	4061.100	0.160
Adj. GDP per capita (1953)	2611	2691.992	4394.901	0.050
Adj. GDP per capita (1956)	2740	2812.055	4670.663	0.427
Adj. GDP per capita (1957)	2922	2842.285	4830.875	0.256
Panel C: Adjusted GDP per capita minus Soviet aid - Figure D3(e)				
Variable	Cuba	Synthetic Cuba	Donor Countries	V-Weight
Urban Share	56.985	37.828	42.338	0.000
Adj. GDP p.c. minus Transf. (1935)	1809	1828.499	2831.749	0.047
Adj. GDP p.c. minus Transf. (1940)	2069	2090.214	3236.639	0.028
Adj. GDP p.c. minus Transf. (1947)	2560	2384.105	3636.430	0.032
Adj. GDP p.c. minus Transf. (1950)	2638	2631.784	4061.100	0.160
Adj. GDP p.c. minus Transf. (1953)	2611	2691.992	4394.901	0.050
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Adj. GDP p.c. minus Transf. (1957)	2922	2842.285	4830.875	0.256

Notes: The predictor balance for Figures D3(c), and D3(e) are identical because the Soviet aid adjustment only affects the post-treatment period. Unless a year is specified, values report the pre-treatment mean.

D.3 Jackknife Test

We also perform a jackknife test. Here, we iteratively drop one country at a time from our donor pool, and reestimate our results.[67] Because our GDP adjustments only affect the post-treatment period, our construction of the synthetic counterfactual is not affected by it, such that we only report the three resulting series in the post treatment period. Figure D4 plots the results, and Figure D5 plots the distribution of the associated p-values.

As in the main results, are results are always significant for most of the post-treatment years, when we consider our two adjusted series (in green and blue). The main difference is that whenever we drop Brazil, our synthetic counterfactual suggests a noticeably smaller effect – but still very large, at around US$ 1,600 ten years after the revolution,.

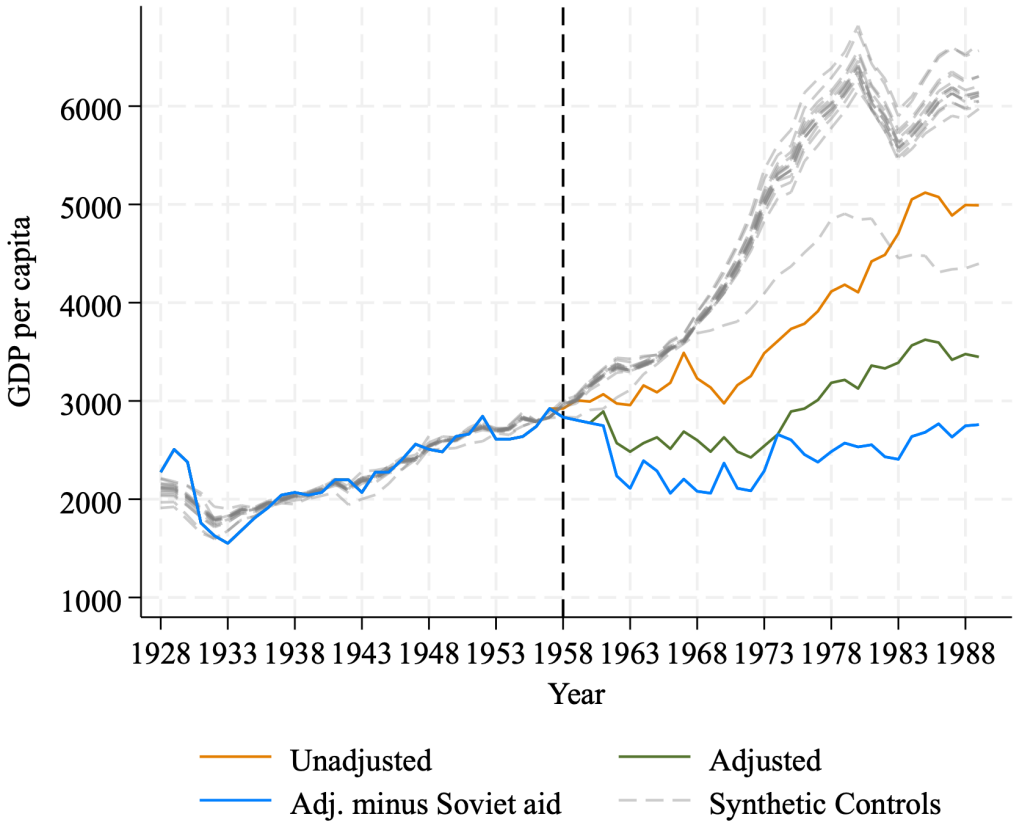


Figure D4: The Effect of the Revolution and Embargo

Notes: This plot shows the combined effect of the revolution and embargo, measured in 2011 Geary-Khamis dollars. Each dashed gray line represents one of the 16 potential counterfactuals estimated by dropping one donor at a time. The unadjusted series simply the 2023 MPD GDP per capita. The adjusted series corrects MPD 1957 onward using Devereux (2021), and the blue series also deduct Soviet and Eastern Bloc aid, retrieved from Devereux (2020).

[67] Donor weights and predictor balance for each iteration are available upon request.

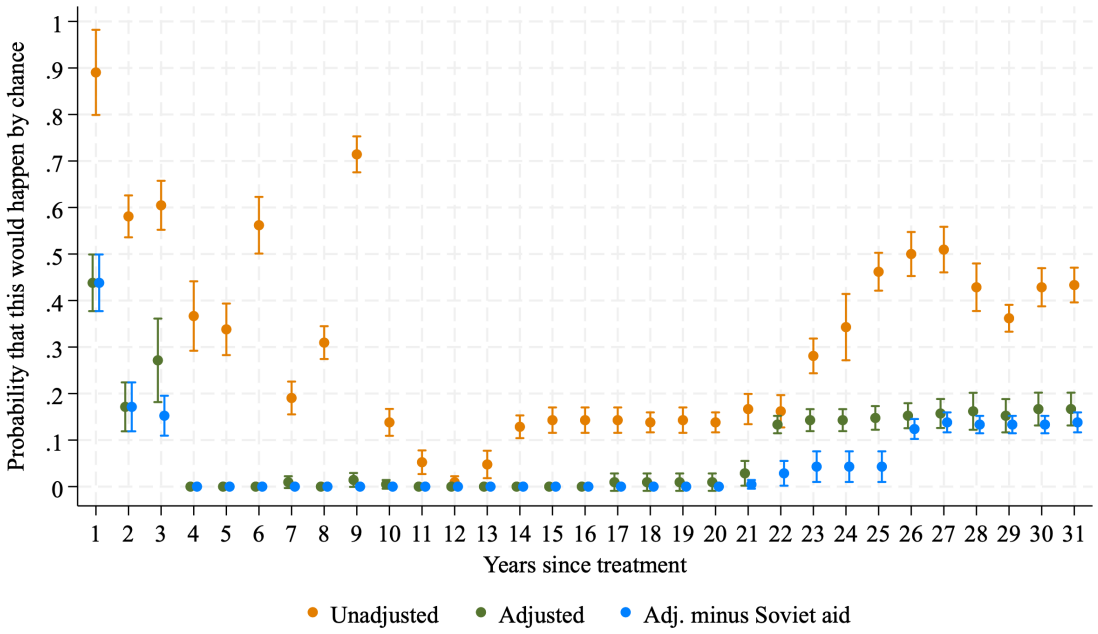
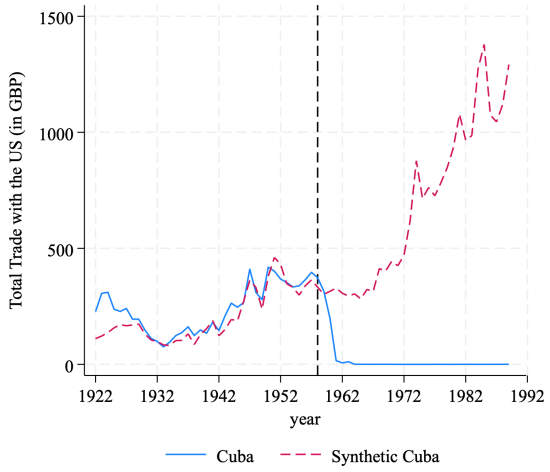


Figure D5: Distribution of Standardized p-values

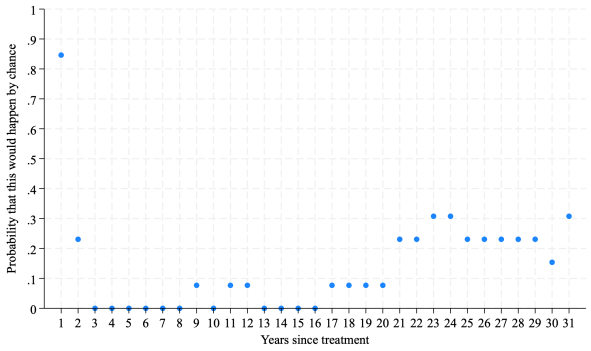
Notes: This figure plots the mean and the distribution of p-values over all jackknife iterations displayed in Figure D4. Points are color-coded to match each series.

E Alternative Trade Data

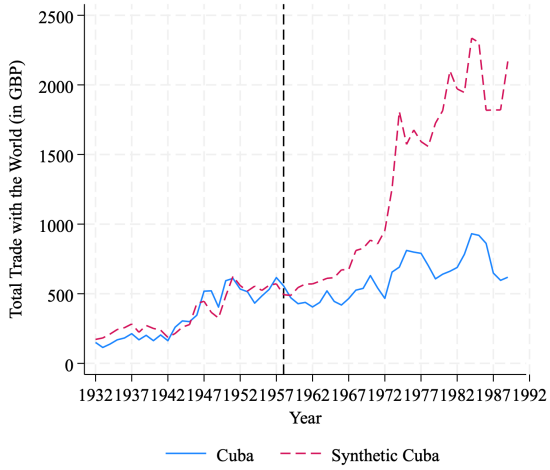
Our main results for consequences of the Embargo focus on its effect on trade openness, i.e. total Cuban trade flows with the world, using data from the Montevideo-Oxford Latin America Database (MOxLAD). Here we provide a robustness check using alternative data compiled by from Fouquin and Hugot (2016). The underlying sources are the following: US-Cuba bilateral flows come from the Carter et al. (2006) (1827-1970), and for 1971 onward from the International Monetary Fund Direction of Trade Statistics (DOTS). Total Cuban imports are sourced from Mitchell (2007) (1900-59) and then from World Bank's World Development Indicators. Exports are sourced again from Mitchell (2007) (1900-47), IMF DOTS (1948-1959), and World Bank's WDI (1960 onward).



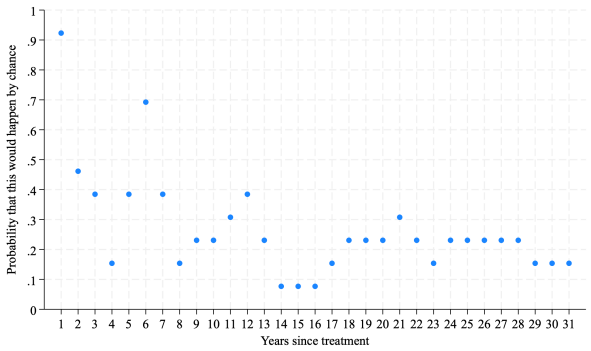
(a) Total Trade with the US



(b) Standardized p-values: Raw GDP per capita



(c) Total Trade with the World



(d) Standardized p-values: Adjusted GDP

Figure E1: Causal Effects of the Embargo and Standardized p-values

Notes: All figures measured in pounds sterling

F Soviet Bloc Collapse

An additional robustness check we propose involves using a different donor pool and a different definition of treatment. In this alternative specification, the donor pool consists of all countries that were part of the Soviet bloc prior to 1989, conditional on the availability of relevant data. In that year, Cuba resembled these countries in many institutional, political, and economic dimensions, particularly in its adherence to a centrally planned socialist model. However, following the collapse of the Soviet Union, most of these countries undertook a transition toward market-based economies and more liberal political institutions. Cuba, by contrast, did not undergo such a transition and instead maintained its socialist regime.

By reproducing the Synthetic Control Method (SCM) approach using this new setup—where Cuba is compared to countries that were similarly structured in 1989 but subsequently liberalized—we can obtain an estimate of the causal effect of not transitioning to a market economy. This represents a distinctly different treatment than that examined in our baseline specification, which centers on the effects of the Cuban Revolution itself. Nevertheless, the two approaches are conceptually linked: both seek to isolate the long-term consequences of Cuba's deviation from broader regional or global institutional trends. While one asks what the revolution changed relative to its regional peers, the other asks what maintaining a socialist system—when others abandoned it—meant for growth (more below on why we say growth). In this sense, the two treatments capture different stages of Cuba's exceptionalism, and comparing them can offer deeper insight into the relative importance of initial revolutionary change versus subsequent policy persistence. In other words, this robustness check is one of conceptual validity to capture whether Cuba's move away from the market-economy setup (relative to others) affected its development path.

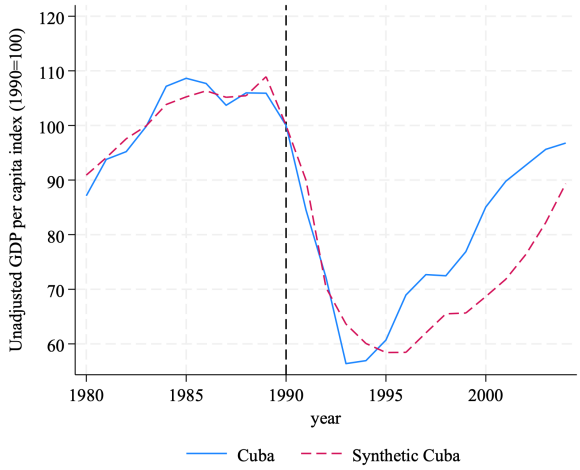
The problem with this approach is that using GDP per capita in levels violates one common restriction of the synthetic control algorithm: the convex hull condition. In the original SCM, the treated unit must lie within the convex hull of the donor pool, which means that all donors receive non-negative weights (Abadie and Gardeazabal, 2003; Abadie et al., 2010, 2015; Abadie, 2021). Put differently, it means that we are not extrapolating the range of the data available. However, this is not a necessary nor a sufficient condition for estimating

treatment effects. In fact, as noted earlier, some have suggested to allow for negative weights, which would enable donor countries to be selected that may or may not be within the convex hull of the treated unit. This could result in a better out-of-sample prediction (Doudchenko and Imbens, 2016).[68]

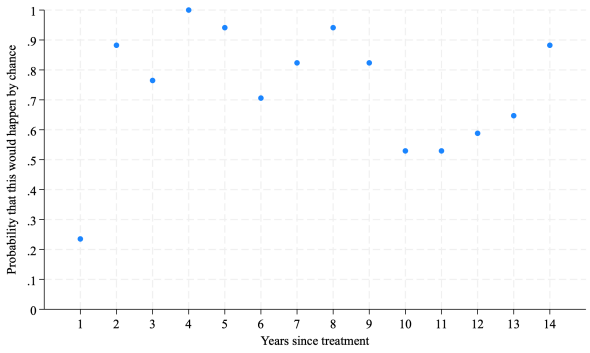
For GDP per capita, the issue is that by 1989, Cuba was clearly a far poorer country than most other countries in the Soviet Bloc (notably in Eastern Europe). Thus, the convex hull restriction cannot be met using GDP in levels. To circumvent this issue, we can fortunately rely on the strategy of indexing values to a base year – in this case the treatment year. This means that we are not selecting weights based on GDP per capita levels but rather on GDP per capita trend during the pre-treatment period, following the intuition of a synthetic differences in differences model (Arkhangelsky et al., 2021; Arkhangelsky and Imbens, 2024). This strategy has been employed previously for infant mortality in Cuba (Geloso and Pavlik, 2021) and size of government in Hong Kong after the departure of a particularly pro-market government official Geloso et al. (2023). This means that the results must be interpreted in terms of speed of economic growth.

In Figure F1 below, we replicate our results with the adjusted GDP per capita from 1980 to 2000. The donor weights and predictor balance are reported in Tables F1 and F2, respectively. We stop just before Cuba's oil-for-doctors deal with Venezuela starts (thus avoiding the issues of Soviet aid being later replaced by Venezuelan aid – see Appendix A).

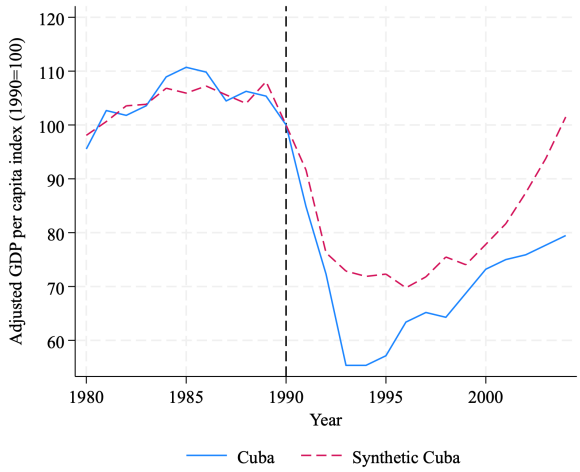
[68] See also the discussions in Ben-Michael et al. (2021); Kellogg et al. (2021).



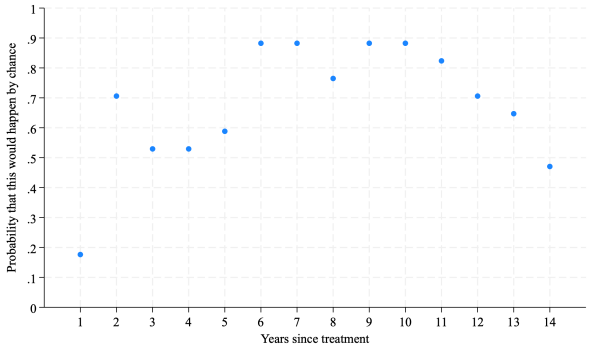
(a) Unadjusted GDP per capita index



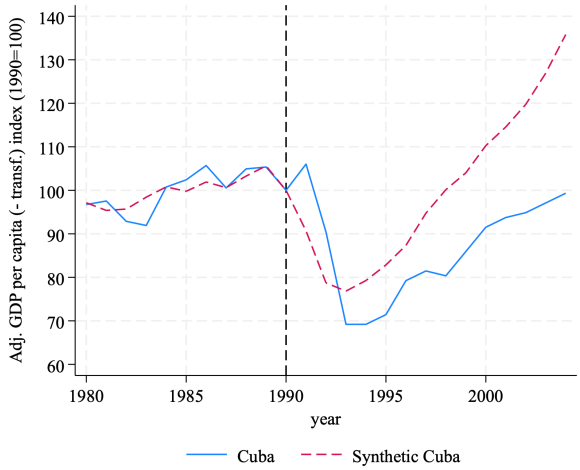
(b) Standardized p-values: Unadjusted GDP per capita index



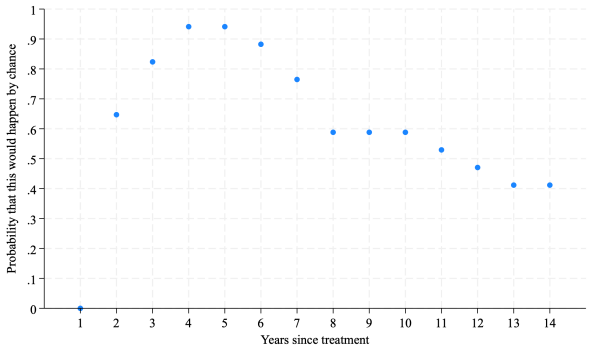
(c) Adjusted GDP per capita



(d) Standardized p-values: Adjusted GDP



(e) Adjusted GDP minus Soviet Aid



(f) Standard. p-values: Adj. GDP - Soviet Aid

Figure F1: Causal Effects of the Soviet Bloc Collapse and Standardized p-values

Notes: All figures plot a GDP index (1990=100). The underlying series are: Panels (a)-(b) the MPD 2023 GDP; Panels (c)-(d) adjust Cuba GDP 1957 onwards using Devereux (2021); Panels (e)-(f) also deduct Soviet and Eastern Bloc aid, retrieved from Devereux (2020).

Table F1: Donor Countries and Weights: Main Results

	Country Weights		
Donor Country	Unadjusted GDP per capita (Figure F1a)	Adjusted GDP per capita (Figure F1c)	Adjusted GDP per capita - Soviet aid (Figure F1e)
Armenia	0.188	0.268	0
Azerbaijan	0	0	0
Belarus	0.401	0.245	0.062
Estonia	0	0	0.129
Georgia	0.221	0	0
Kazakhstan	0	0	0
Kyrgyzstan	0	0.039	0
Latvia	0	0.014	0.397
Lithuania	0	0	0
Tajikistan	0	0	0
Ukraine	0	0	0
Uzbekistan	0	0	0
Bulgaria	0.190	0.434	0
Czech Republic	0	0	0
Hungary	0	0	0
Poland	0	0	0.412
Romania	0	0	0
RMSPE	2.260	2.364	2.680

Note: Percentages may not sum to one due to rounding. Donors are former communist countries that were part of the USSR or Eastern Bloc.

Table F2: Predictor Variable Comparison for Cuba, Synthetic Cuba, and Predictor Weights

Panel A: Unadjusted GDP Index - Figure E1(a)				
Variable	Cuba	Synthetic Cuba	Donor Countries	V-Weight
Urban Share	70.801	61.346	57.952	0.030
Schooling	6.630	9.417	9.201	0.007
GDP Index (1980)	87.121	90.906	98.287	0.294
GDP Index (1984)	107.172	103.837	103.977	0.353
GDP Index (1987)	103.692	105.156	103.364	0.270
GDP Index (1989)	105.899	108.933	106.605	0.046
Panel B: Adjusted GDP Index - Figure E1(c)				
Variable	Cuba	Synthetic Cuba	Donor Countries	V-Weight
Urban Share	70.801	63.348	57.952	0.029
Schooling	6.630	9.389	9.201	0.005
Adj. GDP Index (1980)	95.536	98.074	98.287	0.261
Adj. GDP Index (1984)	108.929	106.828	103.977	0.392
Adj. GDP Index (1987)	104.464	105.586	103.364	0.267
Adj. GDP Index (1989)	105.357	108.051	106.605	0.046
Panel A: Adjusted GDP Index minus Transfers - Figure E1(e)				
Variable	Cuba	Synthetic Cuba	Donor Countries	V-Weight
Urban Share	70.801	64.652	57.952	0.036
Schooling	6.630	8.406	9.201	0.011
Adj. GDP (minus Transf.) Index (1980)	96.730	97.140	98.287	0.313
Adj. GDP (minus Transf.) Index (1984)	100.759	100.789	103.977	0.292
Adj. GDP (minus Transf.) Index (1987)	100.547	100.610	103.364	0.287
Adj. GDP (minus Transf.) Index (1989)	105.357	105.612	106.605	0.061

Notes: Unless a year is specified, values report the pre-treatment mean.

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