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THE POLITICAL ECONOMY OF SUBMARINE CABLES: THE QUANTUM CABLE PROJECT IN THE MEDITERRANEAN SEA

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ABSTRACT

The literature on the political economy of submarine cables is exceedingly scarce and inconsistent. Therefore, this paper aims to address some of the concerns by developing a collection of possible political economy theorisations of the causal mechanisms between the presence and capacity of submarine communication cables and countries' economies and polities. For each theory, this paper assesses the different expectations and policy implications that the instauration of the submarine cable has on the national and regional economies. In the following section, the article employs a qualitative methodology to forecast the different economic and political effects that previous assumptions could have in the new emerging scenario of the Quantum Cable initiative in the Mediterranean Sea. By implementing the previous political

economy models, the article shows the consequences of the Quantum Cable project on the Mediterranean economic structure and relations. Finally, the paper concludes that scholars must account for these dynamics in their future models. This paper aims to encourage further research on the economic, political, and social effects of submarine cables and other Internet connections more broadly. Further, it can theoretically equip other studies on the political and economic preconditions needed for a successful international or regional technological cooperation.

INTRODUCTION

Today, the global economy relies on a complex intersection of communications and trade links between different countries and private firms. Furthermore, especially in the last few decades, the internet started to play a crucial role for national economies and individual companies due to its importance as a communication link for various forms of transactions (Winseck 2017). For this reason, submarine cables are the most crucial infrastructure because they carry almost all of the international communication traffic (Winseck 2017; CCDCOE 2019; TeleGeography 2019). The International Communication Union (ITU) defined a submarine cable system as "a set of equipment designed to permit the interconnection of two or more terminal stations […] usually composed of terminal equipment […] and submersible equipment" (ITU 2020, 2). Indeed, there are more than 356 submarine cables deployed, accounting for more than 1.3 million kilometres (TeleGeography 2019), creating a globalised economic dependence on these infrastructures, which captured the attention of academics and experts, especially after the Covid-19 pandemic and the disruptions in the global supply chain (Feldmann et al. 2020). Some researchers estimated that cables transport data for more than 10 trillion USD each day (FCC 2015). However, few researchers attempted to connect the various economic and political theories to the instauration of the submarine cable

network.[1] The first section attempts to briefly summarise and review the most prominent concepts and scholarships that explained the causes and effects of the implementation of submarine cables. The aim is to create a common framework and new connections between theorisations to allow further research to explore unexplored aspects of the international political and economic environment. In the last section, the paper attempts to implement this new framework to forecast some of the possible and predictable effects that a new cable project, the Quantum Cable, could have in the Mediterranean Sea. This qualitative exercise should be only the beginning of newly active literature that disentails the political economy of broadband interconnections due to the importance of the issue for the global, regional, and national economies.

THE POLITICS AND ECONOMICS OF SUBMARINE CABLES

The critical infrastructure literature conducted many studies on the international submarine cable system. The research question regularly analysed is the consequences of their absence for the global system (Liao 2019). For example, a rupture occurred in 2015 completely cut off the archipelago of the Northern Marianas from international traffic for days, counting economic losses of around 21 million USD for a territory inhabited by barely 50,000 people (ESCAP 2018). More generally, the paper by Franken (forthcoming) measured the threat that damages to cables could have on various territories. He discovered that many countries have "redundancies", i.e., multiple cables connecting them to the global internet. Therefore, only small islands or least developed countries are the most vulnerable to internet outages after a cable failure or disruption, and the only European territory on this list is Gibraltar (Franken forthcoming). This research design is replicable for assessing the dependency level that existing cables generate on domestic and regional economies, but it would be challenging to

[1] For a historical review of the various instruments for global communication and the rise of the submarine cables as the main drivers of such connection, see: Malecki and Wei (2009).

export such a model to study possible future scenarios. Nevertheless, there are some political outcomes that this article highlights. Firstly, legislators need to consider these issues and be prepared to face extreme challenges also posed by possible terrorist attacks (Liao 2019). Therefore, enlarging the networks is crucial for reducing the regional risk to the security and economic systems (Morel 2016). Secondly, governmental actors are dropping, willingly or not, sovereign powers to international and non-governmental institutions that can better administer standards and regulations for possible disruptions (Morel 2019) and to private companies that own the cables (Wheelon 1988). At the same time, these organisations cannot efficiently protect their installations without the active involvement of national security, and their action range is quite limited (Morel 2019). For instance, there are many issues regarding their voting system, with unanimity blocking many decisions, external and self-imposed restraints on their action content, not fully comprehensive membership, and the voluntary or facultative value of the IOs' decisions. Nevertheless, some experts expressed that international cooperation is needed to develop an efficient global network with institutions such as UNCLOS and ICPC more effective than previously stated (Gerlach, Seitz, and Detecon Company 2012).

Other researchers argued in favour of the positive correlation between the instalment of cables and the emergence of local activities, the arrival of foreign companies and investments, and improvements in the communication and connection with the world economy (Hjort and Poulsen 2018). More specifically, the Research Triangle Institute (RTI) employed a different theoretical framework to explain the causal mechanisms between submarine cables and economic development.[2] According to the RTI, the cable deployment enhances the competition level in data traffic,

[2] For the list of research and reports: O'Connor, Anderson, Odufuwa, et al. (2020); O'Connor, Anderson, et al. (2020b); O'Connor, Anderson, Lewis, et al. (2020); O'Connor, Anderson, Lawrence, et al. (2020); O'Connor, Anderson, et al. (2020a).

thus leading to lower internet tariffs and increased speed. With these enhancements, consumers can expand "their consumption of digital content, products and services" while better infrastructure supports business activities in reducing their maintenance costs (O'Connor, Anderson, Lawrence, et al. 2020, 2). Therefore, "new firms and start-ups emerge to serve consumers and businesses" while new business opportunities generate "growth in productivity, efficiency, and revenue for firms" (O'Connor, Anderson, Lawrence, et al. 2020, 2). Consequently, political and economic development are deeply interlinked with internet connections, and the Organisation for Economic Co-operation and Development and the European Union (EU) promote and urge developing countries to follow this approach (Winseck 2017).

Besides, other researchers demonstrated that broadband connections decrease poverty, expand education, foster gender equality, enhance health services, safeguard environmental sustainability, and deliver a stage for international development alliances (Maharaj and Barnes 2015). However, these benefits are connected to investment levels and policy decisions in developing countries since they could fully benefit from this enhanced global connectivity only by implementing the proper strategies (O'Connor, Anderson, Odufuwa, et al. 2020). More specifically, they adopted two econometrics models, difference-in-difference and synthetic control, since regarded as the most suited techniques for this type of empirical exercise (Athey and Imbens 2017). The former approach measures the disparity in the outcome before and after treatment, i.e., the instalment of the cable. By contrast, the latter implements identical reasoning but on a larger and more theoretical scale, employing two different models, one without treatment and the other with it, to estimate the economic impact of the treatment. Although these strategies have critiques and flaws due to challenges in operationalising the explanatory variables and accounting for spuriousness or other external factors, they could still provide applicable policy insights and implications. Firstly, increased connectivity fosters skilled employment, which is

more productive and beneficial for the aggregate economy. Furthermore, high-technological sectors, like financial services, will also profit from enhanced connectivity, expanding trade possibilities and capabilities of governments. By contrast, legislators must be aware that these benefices are restricted only in the areas involved by the new technology, while rural territories cannot directly profit from these enhancements, thus risking widening economic and social disparities. As expressed by the O'Connor, Anderson, et al. (2020a, 18), "the evidence of creation of high-skill jobs and growth in innovative sectors, which holds the promise of resilient growth and improved living standards in the long-run, must be weighed with the trade-offs involving possible short-run losses for certain demographics and any consequences for other sectors". Hjort and Poulsen (2018) discovered similar empirical evidence with improvement in the job market only in connected areas and that less-skilled and less-educated labour benefit less from the technological progress than higher-skilled workers.

Another method to calculate the economic effects of enhanced global connectivity is an augmented production function, following the work by Fosu (2002). Implementing the same theoretical reasoning to construct his equation, the final form, in this case, would reflect the growth in the connectivity level of a country, probably as the variation through time in the quantity of data that it can transfer through its infrastructures.[3] This function is more

[3] However, Fosu (2002) implemented the augmented production function to study the effect of political instability on economic growth. More specifically, he created a double equation where the growth rates of output, labour, capital, and exports are directly linked to the level of political stability in the system. Thus, the production function should be of the type: $Q' = c_0 + c_1 L' + c_2 K' + c_3 C'$ with C', in this case, as the growth level of connectivity of the country with its neighbours. Furthermore, following Fosu's (2002) intuition, the marginal coefficients for labour and capital (i.e., their productivity levels) are also affected by the internet connections, as RTI research also argued in its econometrics findings. Hence, the final augmented production function should be: $Q' = c_0 + c_{11} L' + c_{12} C * L' + c_{21} K' + c_{22} C * K' + c_3 C' + e$ with e as the error term and the effect of connectivity on production as $f = c_3 + c_{12} L' + c_{22} K'$.

rudimental but more effective in delivering the predicted effects of cable instalments in the future. Indeed, it is possible to predict the connectivity growth level while the previous econometric functions can be efficacious only *a posteriori*. Furthermore, the production function can be extended to also assess to what extent different types of connectivity and infrastructure affect the economy.[4] Although there are methodological differences between these two methods, the theoretical background and causal mechanisms connecting cables to economic development are similar but, at the same time, have a significant difference: time. Indeed, the long-term effect, only theoretically advocated by RTI in its previous econometric models, can be immediately and reliably estimated by this production function. The principal implication of this theorisation is that trade and connectivity are deeply interconnected and mutually dependent. Indeed, a detailed analysis of their coefficients reveals that higher connectivity generates more export. Thus, following the idea that more economic power derived through trade construct different political coalitions,[5] a direct effect of submarine cables is the expanded political strength of pro-globalisation and free trade coalitions in the system.

Other theories also correlated the presence of interconnectors and the productivity level in countries. For instance, Duggal, Saltzman, and Klein (1999) discovered that the numerous public infrastructure present in the US after the '70s were the most pivotal drivers of its improvement in production during those years. Further, Oliner and Sichel (2002) reasoned and demonstrated that after 1995 a peak in productivity growth was determined by the renowned interest in investing in IT capital such as hardware, software, and energy and communication infrastructures. Similarly,

[4] Indeed, similarly to Fosu (2002), multiple functions could be created for different link types, such as satellite, submarine, and terrestrial interconnectors, to assess their relative importance in the economic system.

[5] For a critical review of the three main IPE scholarships regarding the correlation between international trade and political coalitions or power, see: De Rogatis (2022).

Duggal, Saltzman, and Klein (2007) demonstrated that information technologies, possessed either by the government or private businesses, were the most significant drivers of economic enhancements in the US economy due to improvement in technical efficiency and enhancement in the possibility of "off-shoring", i.e., establishing some of a firm's processes or services overseas to profit from lower expenses. Therefore, submarine cables expand the possibility of expanding trade with neighbouring countries, not only with financial services but also with commodities and other physical goods, because of enhanced connections with other governments and private actors.

Besides, a more direct method to assess the effect of submarine cables is to estimate their influence on particular sectors of the economy and industries. As summarised by Morel (2019), three private agents principally benefit from this sector: "the suppliers of submarine systems - manufacturers of cables and the equipment necessary for their operation – […]; cable owners [either in consortiums or as alone investors] […]; specialized shipowners who are necessary for the installation and repair of submarine lines" (Morel 2019, 35-36).[6] Moreover, the internet and digital economy could not exist without the existence of global interconnectors enabling the sharing of information between international users (ESCA). Hence, the direct study of the digital sector and its relative growth compared to other economic activities might be a reliable method to evaluate and measure the effectiveness of cable deployments and the extension of their effects on economic growth. However, this approach needs to consider the importance of the digital market compared to the overall economy and the employment switch from old occupations to more technologically advanced ones. Nonetheless, Roberts (2000) demonstrated the importance of new technologies in expanding economic linkages through more reliable and faster communication means and the "knowledge economy". Indeed, elevated connectivity indirectly

[6] The English translation from the French version is produced by the author.

affects individuals by boosting their tacit knowledge of technological systems due to their daily usage (Sosale 2011). This improved knowledge can expand the economic productivity of individuals, becoming a mechanism for economic growth. Therefore, legislators should implement policies that improve this basic and "tacit" knowledge (Roberts 2000) to benefit entirely from the improved global connectivity.

Based on the study and works by Hughes (2012), improved by Flensburg and Lai (2021), the same social institutions require the instalment of additional submarine cables because of their dependence on these infrastructures for their societal functions. However, this expansion directly affects the policymaking process since it significantly expands the relative power of big companies that dominate digital markets and the ownership of their means of communication (Flensburg and Lai 2021). Some countries and the EU especially are currently attempting and fighting to retain some control over those international-leading companies through more restrictive anti-trust legislation regarding the access and structure of the submarine cable and communication markets (European Commission 2022). However, countries that continue to expand their global connectivity have to consider these political externalities and be prepared to defend their sovereign rights from the confrontations with these influential lobbies. At the same time, it should be highlighted that countries have a coercive advantage over private firms since they can amend laws and are the only ones that can effectively protect those infrastructures from external damages like terrorism or natural events (Morel 2016).

The Quantum Cable in the Mediterranean Sea

The "Quantum Cable" is a recent initiative that constructed a 7,700 km long submarine cable which connects Asia with Europe along the Mediterranean Seas, passing by Cyprus, Italy, France, and Spain in order, connecting Kofinou, Genoa, Saint-Hilaire-de-Riez, and Bilbao. This cable could profoundly alter the communication market in the Mediterranean Sea thanks to its capacity to transmit

160 Terabytes of data each second, one of the most advanced and capable connections globally (Quantum House 2020). As previously mentioned, international markets now are most competitive than ever due to their productive and geographical expiation. But how can countries remain competitive in the modern world? According to Porter (1990), "a nation's competitiveness depends on the capacity of its industry to innovate and upgrade", and this ability is greatly affected and enhanced by submarine cables. Indeed, innovation relies on various political, economic, and social conditions generating a more or less nurturing environment for economic growth. First, the factor condition is the most affected by the connectivity since expanding the infrastructure and, consequently, companies' capabilities to extend their productivity and offered services. Besides, the demand condition is also altered since improved connectivity generates more requests for internet or electronic products and services, expanding domestic market opportunities. Finally, enhanced connectivity attracts foreign companies due to the expansion in domestic market opportunities, thus increasing the overall competition level create a downward spiral for production costs and commodities prices. Therefore, the Quantum Cable is a significant opportunity for economic growth in the region since it should improve the competition levels between countries, reduce the costs for consumers, boost international economic attractiveness, and thus increase the number of foreign investments in the country and the expansion of its highly technological sector. Furthermore, the World Economic Forum expressed its concern regarding the widening gap between countries in technology and ICTs levels (Cann 2015). Consequently, the Quantum Cable is an appropriate step forward for the Mediterranean region and Southern Europe due to their structural backwardness compared to Northern countries. Accordingly, the initiative should encourage international companies to implement or expand their digital and data services in the region, thus boosting their domestic economic output and productivity and, thus, reducing unemployment levels. Further, the

Mediterranean region should become more appealing to investors due to the more manageable possibility of extending existing firms with offshoring activities and benefiting from the expansion of skilled labour.

If these hypothesised outcomes should happen, then an AD-AS model could further and efficiently forecast part of the general trends in the regional economic system. Scarth (2010) developed a thorough review of the critiques that the former model is accused of, arguing that, with the due attention and consideration, the model "is a useful framework that seems to make sense of both the warning of Keynes and our current macroeconomic difficulties" (p. 325). Furthermore, Raisová and Ďurčová (2014) empirically demonstrated the validity of the model in forecasting and explaining economic growth despite its generality and simplicity. Thus, it is reasonable to implement such models in the Mediterranean economy on the implementation of the Quantum Cable. Firstly, the aggregate demand (AD) should increase for regional countries since consumers demand more digital products and more brick-and-mortar companies start implementing for the first time e-commerce services. Next, the aggregate supply (AS) should more prominently expand following two mechanisms. Firstly, the technological level in these countries improves, and businesses can generate more profits from the same number of inputs. These enhanced lucrative opportunities incentivise other entrepreneurs to develop new competing activities, thus further expanding production. Secondly, these improvements have spill-over effects in other aspects of economic life. For instance, the trade expansion will advance the private judicial-commercial sector, insurance companies, and, more generally, all financial markets and institutions. Companies should have more resources to invest in R&D, boosting a continuous advancement in technological progress, and on greener knowhows, reducing their impact on natural resources and the planet. In sum, the two shifts in the AD and AS will increase the output level in the economy and

push down the prices for electronic and digital products, a hypothesis that further research could test shortly.

On the other hand, there are other beneficial consequences of improved connectivity. For instance, Cyprus is a small island that heavily relies on submarine cables for broadband connections and communications with other countries. Moreover, Cyprus had many terrorist attacks during the last decades due to the internal dispute between the Greek and the Turkish zones, with the majority occurring during the '90s and some still happening (MONEYVAL 2019; Statista 2021). Moreover, significant and continuous seismic activity characterises the island, especially its Southern coast, thus increasing the hazard of connection ruptures with neighbouring countries (Kazantzidou-Firtinidou et al. 2022). For this reason, this new connection is highly supported by Cypriot politicians since it could drastically reduce the risk that a terrorist attack or a natural event could disrupt all their economic links, with severe consequences for their economy. Similarly, other projects parallel to the Quantum Cable pursue the same principle to reduce dependency on a few submarine cables and the security and economic risk in case of disturbances and ruptures. For instance, there is also an initiative to add an energy interconnector cable between Egypt and Greece, with Cyprus as the intermediary station, to transport a greater quantity of electricity from Egypt and other African countries (EuroAfrica Interconnector 2020).

Furthermore, the Quantum Cable will accompany the construction of an energy-submarine cable called the EuroAsia Interconnector, directly funded by the EU due to its energetic importance, especially nowadays after the Ukraine-Russia war (EuroAsia Interconnector 2022). Indeed, this project derives from the common interest of Greece, Cyprus, and Israel to interconnect the electricity grids with the EU to "creates a reliable alternative route for the transfer of electric energy to and from Europe" (EuroAsia Interconnector 2018, 2). These initiatives also institutionalise the platforms for further international cooperation to create

agreements to defend these cables and links from natural disasters and human misconduct and share unique regulations regarding their usage and maintenance. Therefore, it is probable that other similar projects will occur in the future, enlarging their membership to other Mediterranean countries.

By contrast, Spain and Italy suffered intense economic hardships after the global financial crisis and the following European sovereign debt crisis, while their terrorist threats are narrower than other Mediterranean countries like Cyprus. Therefore, the Quantum Cable is a perfect opportunity to foster the technological advancement, reduce the gap with other European countries, and increase investors' confidence in their economies. Indeed, by expanding and encouraging a growth in the share of GDP derived from high-tech companies, these nations can effectively signal their commitment toward sustainable and prosperous economic development. Similarly, after the crises suffered throughout the last decades, Greece needs an injection of modernity and competitivity for its national industries to export and compete globally and for its consumers to experience lower prices. However, there are some political implications that legislators and scholars must consider in their decisions. Firstly, European states will lose sovereign powers and transfer, willingly or not, to two external entities. Private companies maintain ownership of the submarine cables and the digital services offered, creating a compelling lobby in the national political system. Therefore, countries more convincingly join the EU's effort to constrain private agents' influence, thus further jeopardising their autonomy in critical sectors. Although submarine cables can simultaneously promote economic growth and international cooperation, there are political externalities for various actors, with a probable shift in the balance of power toward the lobbying planned by digital-dependent industries or in the direction of the opposing coalition seeking to defend sovereign powers.

Conclusion

As stated early, the literature on the political economy of submarine cables is fragmented and inconsistent, preventing researchers from discovering and assessing empirical, valuable correlations between global connectivity and its effects on the domestic economy and political system. Thus, this paper aspires to introduce the various fragments already present in the literature and unify them under a common denominator. Although this is only a topic introduction and further research is required, there are some evident and significant economic and political trends. Firstly, everyone agrees that increased global connectivity through submarine cables improves a country's economic performance, either as aggregate GDP growth or productivity. Secondly, most researchers reasoned and demonstrated the importance of these infrastructures for the global economy and telecommunications, studying the security and natural hazards that hinder the structure and proposing possible domestic or international solutions. Lastly, submarine cables' effects derive from enhancement and expansion in the possibilities, benefits, and speed of economic interactions and trade between actors.

Later, this paper attempted to implement these theorisations in an empirical environment, endeavouring to forecast the possible effects of the ongoing project for the Quantum Cable in the Mediterranean Sea. Following the aforementioned theories, economic output and productivity should increase in the countries directly involved in the project with financial and commercial trade. However, there are some political implications at the international and domestic levels. The Quantum Cable and the other interconnector projects are crucial opportunities for the EU to stabilise its negotiation power in the region and create an energy and communication hub that can decrease its dependency on Russian oil and gas. However, the same EU is jeopardised by private companies and other individual actors that collect both economic profit and political influence because of their pivotal role in the modern digital industry. Further research needs to unveil

and disclose those causal mechanisms, explain how the digital sector and its private companies interact with political actors, and promote win-win policy solutions that can nurture economic development without losing political autonomy or integrity.

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