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Shale Renders the ‘Obsolescing Bargain’ Obsolete: Political Risk and Foreign Investment in Argentina’s Vaca Muerta

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Introduction

From a political risk perspective, the recent burst of foreign investment into Argentina's oil and gas sector seems paradoxical, as Argentina's substantial obstacles to foreign investment would seem to weigh against such capital inflows. National politics oscillate between the ideological right and populist left; the country is a stronghold of influential – and combative – labor unions; and institutions are notable for weak enforcement of contracts and property rights. Compounding matters, the Argentine economy is famously volatile, having undergone eight separate defaults on its external debt since independence in 1816¹ and five separate currency replacements since 1970,² with another currency crisis under way in mid-2020. Hence, even among resource investment jurisdictions where risk tolerance is a prerequisite, Argentina stands out.

In addition to political and institutional risk and macroeconomic instability, Argentina's domestic energy policy seeds additional disincentives for investment. In 2017, government subsidies on natural gas and transport accounted for 15% of government spending and 2.2% of GDP.³ However, the scale and sustainability of those subsidies is very much tied to political circumstance, and appeared to hinge on the 2019 presidential election. This only serves to heighten risks around hydrocarbon investment and production decisions. But, perhaps most worrying for foreign investors is Argentina's recent history of state expropriation of foreign-held assets. In 2012 the Argentine government nationalized the holdings of Spanish oil major Repsol, and in 2004 Argentina seized a French-owned water services concession.⁴

Political risk indicators and sovereign debt ratings provide quantitative warnings to large investments in Argentina. While measurable risk indicators declined somewhat during the term of President Mauricio Macri, Argentina's differential on its bond interest rates – bond spreads – was second only to Venezuela's in 2019. On the basis of economic freedom, Argentina ranked 148 out of 186 countries worldwide in 2019 in the Index of Economic Freedom.⁵

Despite this compendium of caution for foreign investors, oil companies – including some of the world's largest shareholder-owned firms – have invested \$13 billion in developing oil and gas concessions in Argentina since 2013. Remarkably, the influx of capital into Argentina began just *one year* after the Repsol expropriation. Most of the investment has been directed toward the unconventional shale play known as the Vaca Muerta, a shale formation in the central Neuquén basin. With 153,000 boe/d in average daily production in 2018 and 268,000 boe/d projected for 2019, the Vaca Muerta has become the most productive shale play outside North America.⁶

Research Questions

Why are foreign investors – including firms owned by risk averse shareholders – are willing to overlook what appear to be significant, persistent risks and invest in Argentina's oil and gas sector? Almost certainly, the election in 2015 of the pro-business

administration of President Macri is one contributing factor. But investment announcements continued seemingly unabated during Macri’s uncertain reelection campaign during summer 2019. This suggests that factors beyond the presidential incumbent were driving the resurgence of foreign investment in the Argentine oil and gas sector. Interestingly, incoming investments were not targeted at Argentina’s conventional oil and gas reserves, where Repsol was overwhelmingly focused prior to expropriation.⁷ Rather, they were aimed at unconventional resources, or shale. The distinction begs the questions:

- Are there aspects of shale resource developments that render them less exposed to expropriation or political interference?
- If so, what are those factors?
- How and why do they seemingly mitigate the various risks that have plagued conventional oil and gas operations?

Argentina’s shale resources are estimated to be world-class in scale and cost. The immense interest by foreign investors will almost certainly trigger a series of midstream and downstream investments – including export facilities and domestic infrastructure in power generation and industrial use – that will be crucial to full monetization of the resource. Hence, understanding the answers to the above questions is critical to understanding how the Argentinian energy sector will evolve.

Findings Preview

There are structural factors unique to shale developments that protect them from the “obsolescing bargain” that incentivizes host country expropriation after foreign capital investments are sunk. The case of Argentina demonstrates that a fundamentally different risk profile exists for foreign investment in *conventional* oil and gas which carries *more* attractions for government interference, as compared with the far *smaller* risk profiles of short-cycle shale prospects. Of course the relative expected profitability of different upstream opportunities matters, but one indicator of the differing levels of risk is the fact that investment has taken place in Argentina within a year of the 2012 Repsol expropriation, but that post-expropriation investment flows have shown clear preference for opportunities in the Vaca Muerta shale basin rather than in the country’s conventional oil and gas resources.

In addition to the commercial opportunity the Vaca Muerta presents, political factors such as the Macri administration’s market-oriented policies and macroeconomic stabilization moves have played supporting roles, as have pacts with organized labor. But we argue that the most significant factor for the revival of energy sector foreign direct investment (FDI) in Argentina is tied to the unique characteristics of shale. Namely, shale has attributes that undermine incentives for governments to interfere in the contractual investment terms, ownership structure, and operation of oil concessions by foreign firms. Conventional oil and gas, by contrast, lacks many of these attributes.

Shale Renders the 'Obsolescing Bargain' Obsolete: Political Risk and Foreign Investment in Argentina's Vaca Muerta

To begin, the full-scale development of a shale asset, using the combined innovations of horizontal drilling and hydraulic fracturing, requires multiple wells drilled with consistent regularity. This is due to the fact that individual shale wells have very short-production cycles. As a result, the upfront fixed costs of basin-level development for a shale resource are distributed across a large number of small wells. By contrast, basin-level development for conventional oil resources is typically focused on fewer well pads and a more concentrated allocation of capital. Thus, basin-wide production growth in shale is critically dependent on a steady capital inflow over time as opposed to more focused, singular, large injections of capital for conventional resource development.

Growth in shale oil and gas production, such as what has been witnessed in the US, is critically dependent on steady capital inflows because individual shale well production peaks within a few weeks, then undergoes a rapid decline reaching very low levels of production (a long flat tail) within two years. As a result, to grow output producers must maintain a steady increase in the rate of drilling. Then, stable production levels require a steady drilling rate. If the drilling process is interrupted, oil production collapses. In this sense, shale production is comparable to a manufacturing process in which systematic operational efficiency is the fundamental determinant of profits. This is a stark contrast to a traditional large conventional oil project in which sizeable upfront capital inflow and initial project execution is central in driving profitability.

Table 1. Payback for an unconventional well in Lea County, New Mexico in 2019 (using actual commodity prices and production data)

EOG Resources, Calm Breeze 2, 4-well pad									
Actual	Wells drilled in Lea County, NM targeting the Upper Wolfcamp.					Well Name		Est. Cost	
						Well #1	CALM BREEZE 2 FEDERAL COM	#701H	(\$7,500,000)
						Well #2	CALM BREEZE 2 FEDERAL COM	#702H	(\$7,500,000)
						Well #3	CALM BREEZE 2 FEDERAL COM	#703H	(\$7,500,000)
						Well #4	CALM BREEZE 2 FEDERAL COM	#704H	(\$7,500,000)
Total Estimated Direct CAPEX								(\$22,500,000)	
Oil Production, Bbl		Oil Disposition, Bbl		Casinghead Gas Production, Mcf		Casinghead Gas Disposition, Mcf		Total Revenue	
WTI Midland Price, \$/bbl		Waha Spot Gas, \$/mcf		Oil Revenue		Gas Revenue		Total Revenue	
Oct-17	224,649		422,591		\$54.93	\$2.40	\$12,339,970	\$1,014,218	\$13,354,188
Nov-17	219,687		400,374		\$57.85	\$2.51	\$12,708,893	\$1,005,539	\$13,714,432
Dec-17	126,563		232,370		\$60.97	\$3.96	\$7,716,546	\$920,185	\$8,636,731
Jan-18	83,117		151,426		\$64.88	\$2.32	\$5,392,631	\$351,308	\$5,743,939
Feb-18	100,065		175,839		\$61.09	\$2.11	\$6,112,971	\$371,020	\$6,483,991
Mar-18	100,843		179,181		\$61.19	\$2.33	\$6,170,583	\$417,492	\$6,588,075
Apr-18	85,008		151,017		\$62.47	\$1.56	\$5,310,450	\$235,587	\$5,546,036
May-18	81,121		153,188		\$55.54	\$1.90	\$4,505,460	\$291,057	\$4,796,518
Jun-18	71,395		132,404		\$61.90	\$1.89	\$4,419,351	\$250,244	\$4,669,594
Jul-18	61,679		115,250		\$53.01	\$2.09	\$3,269,604	\$240,873	\$3,510,476
Total Production	1,154,127	0	2,113,640	0		Total Revenue	\$67,946,458	\$5,097,523	\$73,043,981
Royalty burden (25% of gross revenue)									(\$18,260,995)
Production Expenses (\$8.50/BOE)									(\$12,804,403)
Net Financial Balance After 10 months on Production									\$19,478,583

Source: NM OCD, Bloomberg, Company Reports, Author calculations

This raised the role of a shale development's distinct capital investment profile. The amount of capital at risk in any given moment is typically far smaller than that with conventional oil. Thus, while a conventional project might require a decade or more to repay capital investment and begin delivering positive returns, shale projects tapping the most prolific geology – for instance Southeast New Mexico's Delaware Basin – can yield positive returns in as little as a year, even in a challenging commodity price environment (see Table 1). Even lower-tier unconventional oil wells still have a substantial chance of generating a positive return to initial capital investment by their third or fourth year of production. As a result, the flexibility afforded to capital in shale makes the elasticity of supply higher, or more responsive to commercial factors, such as price, as well as non-commercial risks.

To reiterate, in contrast to shale, traditional oil and gas projects in conventional basins require significant up-front investments to finance huge infrastructure deployments, which cannot be broken into smaller pieces. For instance, in Kazakhstan's massive Kashagan conventional oil and gas development, companies invested \$55 billion before production even started. Sunk costs of that magnitude can take many years to recover. In the case of shale, an individual well on the scale of \$10 million can yield positive cash flow in a much shorter time horizon.

Taken all together, the rapid decline rates of shale wells, distributed sunk costs, and short-term investment recovery reduce government incentives to force contractual abrogation by unilaterally changing profit-sharing or royalty rates, or even consider full expropriation. If a government were to nationalize a shale concession, or otherwise impose terms that render the investment unattractive, shale drilling would cease. Steep decline rates mean that production would soon collapse. The government would soon find itself with very little production and hence cash flow. Even a government with a short-term planning horizon and a technically competent national oil company (NOC) would learn that expropriating a shale operation does not bring the same benefits as the nationalization of a large conventional operation where the upfront capital outlay renders a longer-lived production asset.

The temptation for government expropriation of conventional oil operations is much higher, because of low operating costs and technical expertise required to operate already producing wells, and the long production life of conventional wells.

"Conventional wells decline slowly. You only need operations and maintenance spending to keep them going," said an executive who managed Shell's Argentina operations until 2019. "Unconventional wells decline by 50% per year. You need continuous capital investment. If you nationalize it, you get nothing in two years. Things would dry up very quickly if they expropriated. It would be a very short-lived revolution."⁸ Since shale requires regular investment to sustain production, the investment environment has to stay competitive. That limits the incentives for obstruction for all actors involved – including national and regional government stakeholders, unions, service companies and other players.

Box 1: Expropriation Risk Factors

What makes the oil industry particularly prone to expropriation risks? Key factors include:

Large and volatile rents: Oil extraction often generates significant economic rents, or extraordinary profits in excess of those needed to attract investment. When oil prices are high, rents can be very high, especially when production costs are low. In some cases, the rent portion of oil revenues – the portion left after deductions are made for costs and a reasonable profit – can reach 90%. The availability of rents has brought about high levels of fiscal dependence on oil extraction by host governments. A host government could – in theory – capture all rents and still leave the producer with a sufficient profit to incentivize continued investment. In practice it is hard for governments to capture all the rents because the rent level varies due to price volatility and large cost disparity among reservoirs. Problems tend to arise when governments rely on inflexible instruments such as flat royalty payments to capture rents. These render them unable to capture windfalls from high oil prices. As a result, oil booms have been accompanied by a spike in expropriation (Manzano and Monaldi (2008); Guriev et al. (2011)). Sometimes the government take is delayed by the MNC's cost recovery stipulations, and politicians become impatient to obtain the rents.

Sunk costs and long maturity: Oil investments have been characterized by large sunken investments with high level of asset specificity, i.e. assets that once deployed have a very low value outside the project. Examples include oil wells, field infrastructure, and pipelines. In deep water and large onshore projects, these costs represent the majority of the total investment. Large sunken investments typically have long maturities, in the sense that they generate revenues that repay investment costs over long periods, often decades. Once built, these attributes are exposed to risk of governments changing the terms of the deal. Even when that happens, the producer may still retain sufficient incentive to continue operating as long as it recovers operational and non-sunk costs. Thus, sunken investments constitute what is referred in the economic literature as appropriable quasi-rent (Hogan and Struzenegger (2010); Chang et al. (2018)).

Declining geological and economic risks: Oil and gas projects differ significantly in their economic and geological risks, and these risks also vary in the different stages of the project. In developed basins with well-known geology and pre-existing infrastructure, risks are much lower than in unexplored areas with difficult access. Risks that may be high in the initial exploration phase decline as knowledge of the basin increases. Declining risk creates incentives for contract renegotiation and expropriation. The investment conditions that were necessary to attract investment in high-risk projects appear too generous once a good outcome materializes (Manzano and Monaldi (2008); Nolan and Thurber (2012)).

Widespread domestic consumption: Fuels like gasoline, diesel, and natural gas are widely consumed by the population. Spending on these fuels could represent a significant share of the budget of poor families. As a result, domestic pricing of energy is politically salient and governments have incentives to force producers to sell below the opportunity cost (Krane and Monaldi (2017)).

Weak institutions: Expropriations are more likely in countries with weak institutions, such as rule of law, and few limits to executive power. Other enablers include policymaking horizons skewed toward short-term gains over long-term benefits (Barma et al. (2021)). External enforcement mechanisms provide some deterrence, but have proven to be ineffective when governments have significant incentives to expropriate (Lipson (1985); Monaldi (2017)).

It is worth noting that the case for protection from political risk for shale gas may be less convincing than for shale oil, although the risk may manifest indirectly. Argentina’s relatively underdeveloped market for natural gas is too small to absorb increased production from the Vaca Muerta, and would require major investment in export capacity – pipelines or liquefaction – or new sources of domestic demand, such as petrochemical production and power generation. For foreign investors, large sunk investments in midstream and downstream assets could increase political risk exposure. Of interest here is the oil-gas ratio of oil-directed production assets. If midstream and downstream risks in the gas sector are deemed high, this could lead to more gas flaring, which is undesirable from an environmental perspective and could challenge sustained capital investment by integrated oil and majors who are active in reducing gas flaring in their operations. So, to the extent ESG directives from the broader international investment community are relevant for firms active in the upstream unconventional space in Argentina, government actions that incentivize gas flaring will become a burden for continued capital inflows.

In summary, we hypothesize that tight oil and shale gas extraction is exposed to fewer expropriation risks than conventional oil and gas, and as a result, Argentina is likely to attract more investment in the Vaca Muerta formation than would otherwise be realized given its recent history. Moreover, while we focus here on Argentina, the case has implications for the global oil market. If risk is institutionally and structurally lower in shale investments, the realization could encourage wider proliferation of shale production outside the United States, all else equal.⁹ That could, in turn, result in a broader geographic distribution of oil production beyond the major producer states that dominate – and often manipulate – oil markets. Eventually, it is conceivable that widespread low-risk shale production could undermine the market power of OPEC.¹⁰

The Political Economy of Expropriation Risk: Shale vs. Conventional Oil

The oil industry in Latin America, as well as other developing regions, has experienced multiple episodes of “resource nationalism” through, for example, forced contract renegotiation, unilateral demands for improved payment terms, and interference up to and including outright expropriation. These “above-ground risks” to oil and gas investment in developing countries can be such significant deterrents that foreign investors often move ahead only under conditions that allow high returns in as short a term as possible.

The incentive to expropriate foreign oil holdings was initially described by Vernon (1971) as the result of an “obsolescing bargain” between governments and investors.¹¹ The “bargain” is a model of interaction that initially favors the multi-national corporation (MNC), because governments are initially eager to attract foreign investment in extractive industries and offer generous terms. But once the investments occur, the bargaining power and incentives shift toward the host government and away

from the MNC. At times when initial terms are perceived as over-generous, governments may react by changing contractual terms or expropriating MNC holdings.

A series of structural characteristics render the oil and gas sector particularly prone to expropriation. These include high and volatile rents, large upfront fixed cost investments with long-dated maturities, and significant initial reservoir risks that decline over time (Hogan and Struzenegger (2010); Manzano and Monaldi (2010); Warshaw (2012); Nolan and Thurber (2012); see Arbatli (2018) for a literature review).

Expropriation Risks Facing Conventional Oil and Gas Extraction

The history of Latin America is replete with episodes of expropriation in the oil industry. The full nationalizations of Mexico (1938), Bolivia (1937 and 2006), Venezuela (1976, 2005 and 2007) and Argentina (2012) figure prominently. Numerous episodes of contract cancellation and forced renegotiation short of full expropriation have also taken place in Argentina, Bolivia, Ecuador, and Venezuela.

In addition, numerous examples of unilateral fiscal and regulatory changes could be considered “creeping expropriation” (Manzano and Monaldi (2008); Joffe et al. (2009)). A common method of expropriation of profits occurs when the state sets the domestic prices of oil products below international market prices. Expropriations have also happened in other extractive sectors (for example, copper mining) as well as utilities, which share some features with the hydrocarbon industry, notably large upfront fixed costs with long-lived infrastructure, but the oil industry has been generally the most affected by this phenomenon.

Cycles of Investment and Expropriation

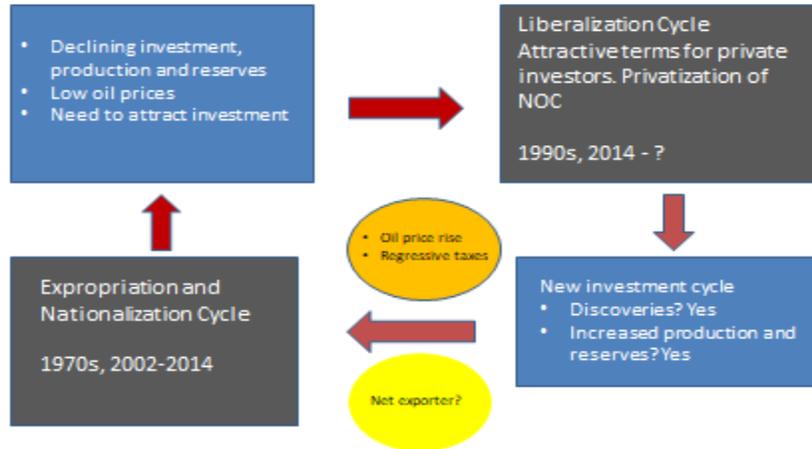
The conventional oil sector faces regular bouts of risk from “expropriation cycles.” The short-term benefits of expropriation can be high, while the costs – production decline, foregone revenues due to a slowdown in FDI, and reputational damage – are often realized over the longer term. In other words, there is a temporal mismatch between the *political* incentives (with short-term horizons) and the *commercial* incentives (with long-term horizons), and this mismatch of incentive structures remains a source of conflict in conventional oil resource developments (Manzano and Monaldi (2008)).

The likelihood of expropriation also varies with other structural characteristics. Oil exporting countries tend to be fiscally dependent on resource rents and more likely to act on a resource nationalist basis. Net importers, by contrast, are typically focused on incentivizing production and self-sufficiency, rather than capturing rents. Countries with increasing production and reserves are less likely to care about the costs of expropriation, but countries with small or rapidly depleting reserves are compelled to be less resource nationalist (Manzano and Monaldi (2008)).

Figure 1 summarizes the structural logic of the cycles. When investments are needed because production and reserves are declining, prices are low and NOCs are in difficult

financial shape, a liberalization cycle occurs, similar to the 1990s and post-2014. When a successful investment cycle leads to increased production and reserves and the oil price goes up, an expropriation cycle tends to occur, similar to the 1970s and the 2000s. Structurally, the oil and gas industry has characteristics that make it susceptible to outright expropriation and government-invoked *ex post* changes to previously agreed upon investment terms.

Figure 1. Liberalization and expropriation cycles affecting oil-exporting countries



How does Argentina fit this profile? Argentina has repeatedly demonstrated institutional weakness in areas such as property rights. Furthermore, the country's oil taxation system – a 12% royalty rate and 30% corporate income tax rate – is fixed. Regressive taxation regimes represent another incentive for the state to alter terms, or engage in outright expropriation, because when oil prices rise the foregone contemporaneous revenue to the state can become a political rallying point that garners broad support without full internalization of the long term ramifications for foreign investment and future revenues.

However, as argued herein, conventional and unconventional oil and gas do not share the same risk profile. Unconventional resource extraction has lower upfront fixed costs and shorter maturities, as well as lower geologic uncertainties and price risks. These facets provide strong deterrents to would-be state expropriators, and the recent influx of capital in Argentina's upstream sector has been directed at shale.

Argentina presents a case study of the evolving incentive structure that allowed Repsol's holdings to be expropriated in 2012 but, just one year later, afforded sufficient assurance for renewed foreign investment. Argentina provides an ongoing experiment that, as of mid-2019, has supported the thesis that shale production has lower expropriation risks, both in terms of the likelihood of expropriation and in terms of the size of the capital investment exposed to that risk.

Other Factors that Differentiate Shale and Conventional Oil

There are numerous distinctions between shale and conventional resources other than political risk. In the US, shale oil production has become a “modular” process with interchangeable field services firms and well-known development stages. While expropriation risks are non-existent in the US, modularity in the investment and production process is relevant because it makes shale assets less vulnerable to such concerns. It also allows producing firms to exercise discretion in the timing of subsequent investments in a shale asset, and to dynamically fine-tune their actions in response to host government actions.

In contrast, a large project in conventional resource development, such as the previously mentioned Kashagan, is more exposed to expropriation risk because shallower decline rates after production commences can allow even a technically incompetent expropriator to reap gains for years through multiple commodity price cycles.

Consider Venezuela from 2004 through 2015.¹² The Chávez administration abrogated contractual terms and increased the government take dramatically in the large extra-heavy oil projects, hiking the royalties from 1% to 33%, the income tax from 34% to 50%, and adding a windfall profit tax. Venezuela partially nationalized the equity of the international oil companies and compensated them well below market value. As a result, ConocoPhillips and Exxon left the country and entered into international arbitration, but output from their former assets remained largely stable until around 2015, despite little additional investment. Of course, major declines set in later, which is symptomatic of the long-term ramifications of such aggressive government policy, and by 2019 Venezuelan oil production had fallen by nearly two-thirds to 1.1 million b/d.

Expropriated shale assets would provide a far shorter “honeymoon” period of lucrative output because decline rates are so steep.¹³ The constant investment required to maintain field and basin level production may reduce a host government’s incentive to capture it in the first place. If governmental interference caused curtailment of operations, the ensuing rapid production decline would exert serious fiscal pressure within a matter of months upon political constituencies dependent on oil and gas revenues.

While some national oil companies – notably YPF – might acquire technical knowledge necessary for shale operations, a steady flow of capital investment is required to maintain production. This is where the expropriating host government would inevitably be challenged.

Shale plays may also create stronger domestic political support bases than conventional oil and gas projects because the shale value chain is longer, more labor-intensive per unit of production, and because of requirements for repeated capital investment. This broadens (and often localizes) industry’s contribution to economies in and near the development area.

Box 2: Structural Enablers of the US Shale Boom

Unconventional oil and gas developments in the United States have been enabled by several factors. Geology is the most fundamental of these, but insufficient on its own.¹⁴ In general, a host of political/institutional factors and industrial/market factors are required for sufficiency, and they all pertain to "above ground" matters that can vary across shale basins.

Political/Institutional Factors

PRIVATE MINERAL RIGHTS OWNERSHIP. Private mineral owners are strongly incentivized to work with companies wishing to develop those minerals, as royalties can range from 10% to as much as 25% of the gross revenue generated by oil and gas produced from their holdings.

ROBUST PROPERTY RIGHTS PROTECTIONS. Protection of private property and contractual rights through a legal system where cases are adjudicated transparently fosters confidence among investors. An independent judicial system can also protect against interference by politicians and regulatory agencies.

LOW POPULATION DENSITY. Unconventional oil and gas developments face steeper political challenges in densely populated areas. This has been the case in Britain and other parts of Europe, but also parts of the United States such as northeastern Colorado's DJ Basin.¹⁵

A TRANSPARENT, COMPETENT, POLITICALLY INDEPENDENT REGULATORY PROCESS.

LOW DEGREE OF GOVERNMENT INVOLVEMENT. In the US, government is first and foremost a "referee" through regulation at the local, state, and federal levels. Governments participate financially through royalty collection. Exploration and production activity is delegated to the private sector.

Industrial/Market Factors

A DIVERSE SECTOR WITH DOZENS OF INDEPENDENT PRODUCERS. The US shale sector has incentivized companies to take an innovative and risk-embracing approach to development. Multiple producers collectively drilled thousands of wells per year, which provided learning-by-doing experience that guided subsequent development.

DEEP AND INNOVATIVE CAPITAL MARKETS. US capital markets have been willing to finance small firms (and later, large ones) seeking to develop the unconventional resource base. Flexible capital markets can also help nascent developers weather global commodity price shocks. Over the past decade, US E&P companies have raised \$300 billion from bond issuances alone.¹⁶

ROBUST AND ADAPTABLE OILFIELD SERVICES SECTOR. Unconventional oil and gas developments are extremely services-intensive. Having an efficient, responsive set of drilling service providers can help producers drill more wells faster, which ultimately helps manage costs and exposure to commodity prices during a drilling program.

SUBSTANTIAL PRE-EXISTING INFRASTRUCTURE, and a transportation market that responds to market signals.

Collectively, the political and institutional factors reduce structural risks to investors who contemplate installing physical infrastructure. The industrial/market factors help broadly mitigate risk and drive down costs, a core determinant of commercial competitiveness in global commodity markets.¹⁷

The Case of Argentina

Given the factors in Box 2, Argentina presents a discouraging case for successful shale development. The country's undeniably attractive geology, which plays a significant role in its attractiveness to foreign investment, is coupled with just two other structural enablers. First, the province of Neuquén (which encompasses most of the Vaca Muerta) has a low population density of about 18 people per square mile, about three times the Permian's very low density of 6 people per square mile, but far lower than the 104 people per square mile in Pennsylvania's Marcellus shale. Second, Argentina's federal system allows significant subnational autonomy over natural resources, labor and contract governance. In fact, Argentine resource governance resembles that of the United States, where some subnational governments are more amenable to oil and gas production than others.

Argentina's political history presents caution. Historically, Argentina has oscillated between autocracy and democracy. This process ended when Argentina returned to democratic rule in 1983, and democracy is now well-consolidated in the country.

Similarly, Argentine economic policy has swung between state-led economics and free market alternatives. President Raúl Alfonsín's (1983-89) statist approach gave way to President Carlos Menem's (1989-99) free market embrace, which was continued by his successor President Fernando de la Rúa (1999-2001), who resigned amid Argentina's 2001 economic collapse. Interim President Eduardo Duhalde (2002-03) engaged in post-collapse damage control before handing the reins to President Néstor Kirchner (2003-2007) who steered the country back to a statist model. Intervention deepened during the two terms of President Cristina Fernández de Kirchner (2007-15). Finally, the election of President Mauricio Macri in 2015 signaled the return to a market-oriented government that encouraged investment in the energy sector via policies that favored rule of law and increased transparency and.¹⁸

Argentina is also a country with extreme congressional malapportionment, which provides the sparsely populated petro-provinces with an outsized level of influence in the Argentine Congress compared to the populous provinces of Buenos Aires, Córdoba, Santa Fe and the City of Buenos Aires.¹⁹ The Patagonian provinces of Neuquén, Chubut, Santa Cruz, Tierra del Fuego, and Río Negro dominate oil and gas production in Argentina.²⁰

In 2019 Neuquén accounted for 54% of Argentine natural gas production and 26% of its petroleum production, Chubut for 6% of natural gas production and 30% of petroleum production, Santa Cruz for 9% of natural gas production and 18% of petroleum production, Tierra del Fuego for 8% of natural gas production and 2% of petroleum production, and Río Negro for 6% of natural gas production and 4% of petroleum production. Combined, these five Patagonian provinces produce 83% of Argentina's natural gas and 80% of its petroleum, with offshore production accounting for 11% of natural gas production and 1% of petroleum production. In sum, Argentina's 19 other

provinces combined produce only 5% of its natural gas and 19% of its petroleum (IAPG 2019).²¹

Table 2 underscores the overrepresentation of the Patagonian petro-provinces in the Argentine Congress. They contain 5.5% of the population but elect 10% of the deputies and 21% of senators. This stands in contrast to the four most populous provinces in the country (which also account for over 90% of Argentina’s manufacturing production), which together hold 62% of Argentina’s population but elect only 51% of the deputies and 17% of the senators.

Table 2. Provincial Shares of Population and Political Representation

Region	Province	Population Share	Deputies Share	Senate Share
<i>Patagonia</i>		5.5%	9.7%	20.8%
	Río Negro	1.6%	2.0%	4.2%
	Neuquén	1.5%	2.0%	4.2%
	Chubut	1.3%	2.0%	4.2%
	Santa Cruz	0.7%	2.0%	4.2%
	Tierra del Fuego	0.4%	2.0%	4.2%
<i>Metro Provinces</i>		61.7%	51.4%	16.7%
	Buenos Aires	37.1%	27.2%	4.2%
	Córdoba	8.7%	7.0%	4.2%
	Santa Fe	8.2%	7.4%	4.2%
	City of BA	7.7%	9.7%	4.2%
<i>Other Regions</i>	15 Provinces	32.8%	38.9%	62.5%

Furthermore, under Argentine law, oil and gas deposits fall under the jurisdiction of the provinces in which they are located. National jurisdiction is limited to national waters beyond 12 nautical miles. The provinces are allowed to adopt energy related policies of their own, as long as they do not conflict with those of the national government, with the Argentine Congress retaining ultimate authority.

Current legislation endows provinces with the power to regulate and supervise exploration and production, and sanction producers for any violations. Provincial governments collect royalties from upstream oil and gas production, while the federal government taxes the companies’ income. Provincial authorities can extend concession agreements and make some contractual modifications. As this division of power suggests, Argentine provinces enjoy substantial political autonomy. Federalism in Argentina affects almost every dimension of political competition in the country, even beyond subsurface resource management.²²

The provincial nature of Argentine politics has profound implications for politics and policy. Given the strong powers possessed by governors and subnational party leaders, provincial actors tend to rule over candidate selection mechanisms for most offices, which endows them with considerable control over the behavior of these elected officials. The use of a closed list at the national legislative level reinforces these tendencies and tends to engender loyalty and discipline in the Argentine Congress. Given the congress' low reelection rate – six out of seven legislators serve only a single term in office – the levels of expertise in Congress are poor and the institution itself is relatively weak, particularly in comparison with certain governorships and mayoralities endowed with considerable influence.

Provincial executives have become pivotal actors in national politics. Decentralization during the 1990s transferred multiple responsibilities to their administrations and allocated funds to the provinces with few accountability requirements. Legal changes also removed obstacles to their reelection, which has been further enabled by patronage practices.²³ Provincial leaders' primary interests thus tend toward passage of distributive policy and parlaying their legislative support (i.e., the votes of their legislators) into financial benefits in the form of transfers, subsidies, government posts, and federal spending in their regions.²⁴

Organized Labor

Argentina is one of the most unionized countries in the Western Hemisphere. More than a quarter (28%) of Argentine workers belong to a labor union.²⁵ The combination of strong unions and labor laws make it difficult to dismiss employees without large severance payments. Influential labor unions add to the list of risks for foreign investors, which includes Argentina's alternating governance philosophy, powerful presidents, and weakly institutionalized national parties. Any of these factors can result in substantial modifications in energy policy, particularly during periods of Peronist Movement incumbency.²⁶

Unions are especially active in the energy industry, with virtually all work associated with the exploration, development, production and transport of energy carried out by union workers. Unionized sectors include construction, truck driving (Teamsters), and oil field workers. Two regional oil workers' unions are considered to be the most influential given that two-thirds of Argentina's energy production occurs within their domain – the Oil and Gas Union of Río Negro, Neuquén and La Pampa, and the Oil and Gas Union of Chubut.

Oil in Argentina and the Ownership of YPF

The Argentine hydrocarbon industry dates to the early 1900s when petroleum was discovered near the city of Comodoro Rivadavia, in what would in 1955 become the province of Chubut. In 1922, then President Hipólito Yrigoyen created a national oil company, Yacimientos Petroleros Fiscales, or YPF. YPF would remain a national oil

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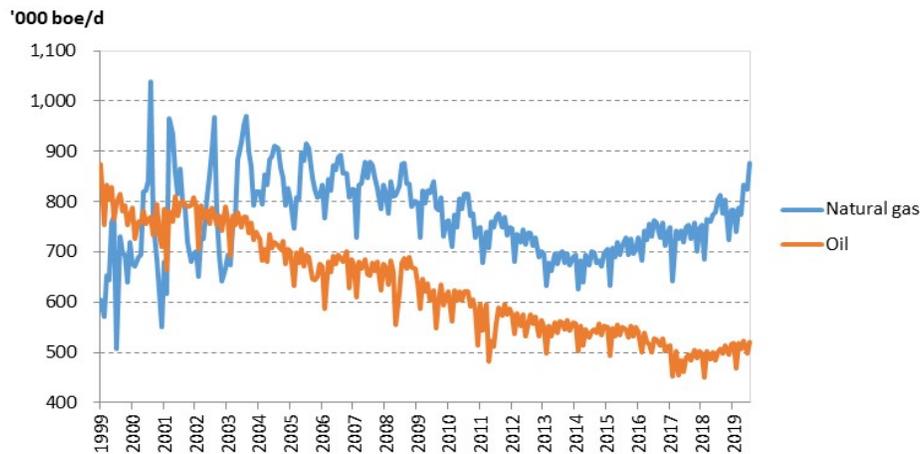
company and the dominant actor in Argentine oil and gas for the next 70 years, alongside varying levels of foreign participation.

In 1989, President Carlos Menem was elected in the midst of a major economic crisis. As part of his implementation of an IMF austerity plan, Menem pursued neoliberal reforms that included the transformation of YPF from an inefficient source of patronage to a modern NOC in the mold (circa 1990) of Venezuela's PDVSA and Brazil's Petrobras.

In 1999, Menem's final year in office, Argentina sold a minority stake in YPF to the Spanish company Repsol. The Spanish firm assumed operational control of YPF and quickly acquired a majority stake in the firm. By 2000, Repsol had accumulated 99% of YPF's shares. Repsol would retain operational control of YPF until 2012 when, during the administration of President Cristina Fernández de Kirchner, the government unilaterally re-nationalized YPF. The nationalization succeeded in recapturing Argentine operational control of YPF by seizing 51% of Repsol's Argentinian assets. Repsol accepted \$5 billion in compensation for its losses.²⁷

The rationale for renationalizing YPF was said to be due to its failure to adequately produce oil and gas in Argentina. Indeed, the company's production levels did plummet during Repsol's tenure, but the decline was due in large part to state price controls in place during the governments of Néstor Kirchner (2003-07) and Cristina Fernández de Kirchner (2007-15). Such policy rendered domestic sales of oil and gas unprofitable and discouraged Repsol from further investment in new production.

Figure 1. Argentine gas production has recovered to 2008 levels, while oil production has reached a four-year high



Source: Secretaría de Energía, Argentina 2019

Also driving the renationalization was Cristina Fernández de Kirchner's desire to have direct access to the hydrocarbon revenue to fund populist increases in social welfare benefits and the government workforce.

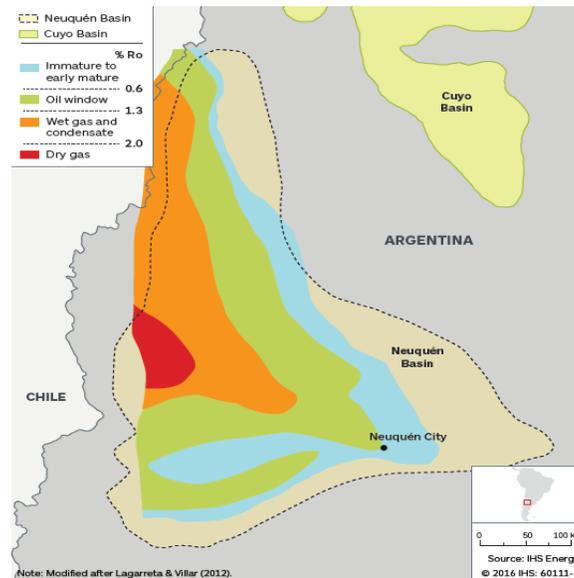
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Under the presidency of Mauricio Macri (2015-19), YPF remained under the operational control of the Argentine government, but price controls were gradually relaxed (with the exception of a 90-day price freeze on petroleum, natural gas and refined products after the Argentine Peso lost 20% of its value in August and September 2019). New policies encouraged exploration and investment. Argentine gas production rose to levels not seen since 2008, while oil rose to a four-year high (see Figure 2).

Evidence: Foreign Investment in Argentina's Vaca Muerta Shale

Recent investment activity in Argentine hydrocarbons has focused on the Neuquén Basin's Vaca Muerta shale formation, rather than the country's conventional reserves. The Vaca Muerta formation is one of the most hydrocarbon-rich shale formations in the world. It is comprised of multiple layered reservoirs, like the Permian, but with brittle carbonate shales akin to those in the Eagle Ford shale. Vaca Muerta shales contain both conventional (high porosity) and unconventional (low porosity) reservoirs ranging from heavier black oils to dry gas. The 44,400 square-mile (115,000 sq. km.) shale play is thick, ranging from 300-700 feet (100-200 meters), and it drops in depth from east to west, with surface formations exposed in the east while the western edge lies at depths of 13,000 ft (4,000 m) at the base of the Andes in the west.²⁸

Figure 2. Maturity of the Vaca Muerta Formation



Source: IHS Energy Insight

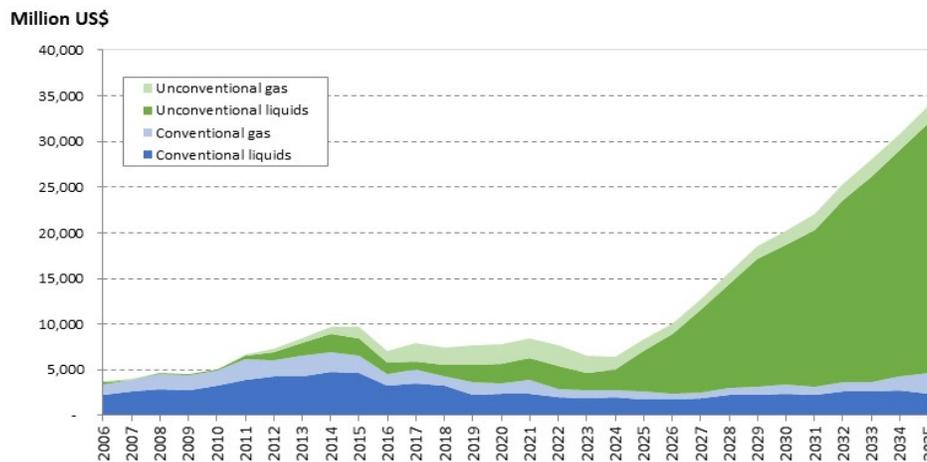
In 2016, the USGS estimated the Neuquén Basin held recoverable reserves of more than 14 billion barrels of oil and 38 trillion cubic feet of natural gas, making Argentina the fourth-largest holder of shale oil reserves and the No. 2 holder of shale gas reserves worldwide.²⁹ However, the shale had not undergone sufficient drilling to be fully characterized at the time of writing.

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Still, the considerable risk environment in Argentina augured against foreign investment. The Repsol expropriation came against a history of economic collapse, including the hyperinflation in 1989 and the largest sovereign debt default in history in 2001. Despite Macri’s “market friendly” tenure, the country underwent two years of recession with Argentine peso losing two-thirds of its value and unemployment rate hitting 10 percent. Macri managed to procure an IMF financial rescue package, but at the cost of foreign debt soon to surpass Argentina’s annual GDP.³⁰ In September 2019, Argentina began gyrating into yet another currency crisis.

Despite all of this, foreign firms continue to express a capital interest in the Vaca Muerta. Investment commitments in the Vaca Muerta remain modest on an international basis, but have risen from \$3 billion in 2013 to \$4 billion in 2018 to \$7.5 billion in 2019, with 30 companies taking part. About half of the investment in 2018 flowed from companies outside Argentina.³¹ Figures 4 and 5 reveal a shift in investor preference for shale developments.

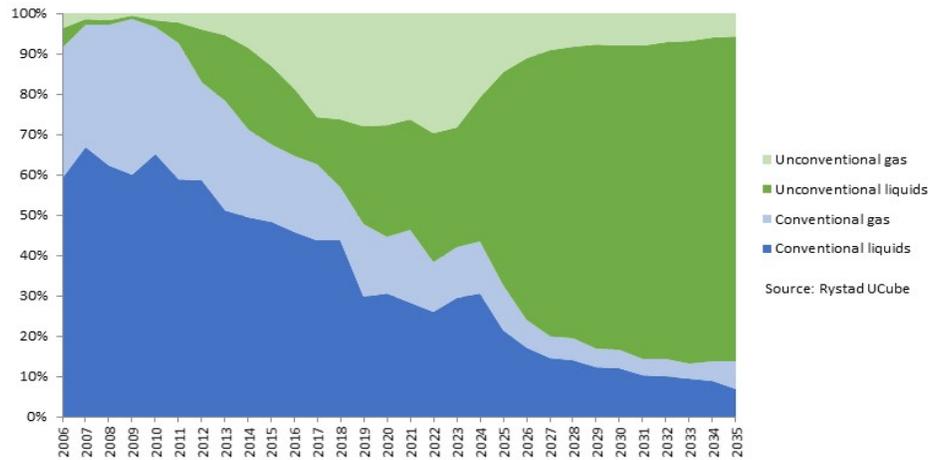
Figure 3: Capital investment in oil and gas in Argentina is expected to shift toward unconventional oil (forecast begins in 2019)



Source: Rystad UCube

Oil from the Vaca Muerta was, by mid-2019, compensating for declines in Argentina’s conventional production and returning overall production toward growth. By June 2019, Vaca Muerta investments had produced two export cargoes – one of light oil (exported by Mexico-based producer Vista Energy) and another of LNG (exported by YPF using a small floating liquefaction barge with a capacity of 500,000 metric tons per year).³² The country’s Energy Secretariat said nationwide output in May 2019 was 506,000 b/d up 4.2% from 485,000 in May 2018.³³ The Argentine government forecasts production will reach 1.5 million b/d by 2030. By contrast, investment into Argentina’s conventional oil and gas resources has stagnated.

Figure 4: Capital spending ratio - Conventional investment fell below 50% by 2018 (forecast begins in 2019)



Source: Rystad UCube

Caveats: Investor Caution

However, oil development in Argentina – conventional and otherwise – was proceeding slowly in 2019 due to a number of factors that increased caution of oil companies to commit to final investment decisions. First, most firms have obtained 35-year concessions that provide longer opportunities to test and optimize well completion designs, compared to the short lease terms that force faster development in the US shale patch. In addition, obstacles related to a shortage of oil and gas pipeline capacity, shortages of fracking sand, and insufficient road and rail infrastructure have created delays in various dimensions.

Political risk associated with the October 2019 presidential election cast a shadow of doubt. Some firms were said to be delaying major outlays until policies of the forthcoming administration were understood.³⁴ Physical infrastructure, in particular, that could be targeted for expropriation – such as pipelines, LNG export facilities or chemical plants – were being left to Argentine firms, partially due to political risk.³⁵

Government policy changes have created yet more disincentives for companies marketing products domestically. Reductions in Argentina's government subsidies for energy commodities, which have raised domestic prices and boosted revenue for producers, was affecting earnings and investment in non-energy sectors and triggering disputes between companies and the government. Overall, of the 31 projects launched since 2013, 10 are producing and only five others have received final investment decisions for full development.³⁶

Regardless, foreign investors are returning to Argentina. The next section examines the largest participants in the Vaca Muerta shale. The size of the individual investments and projects lends strong support to our theoretical claims; namely, that shale's short

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investment and payback cycles allow for smaller investments, which, in turn, better enable foreign firms to participate in an uncertain and risky political environment.

YPF and its Partners

The largest owner of surface acreage and below-ground reserves in the basin is Argentina's Yacimientos Petrolíferos Fiscales (YPF). Exploratory shale drilling began in 2009 under Repsol-YPF, and the first shale oil discovery was announced in 2010. After the 2012 nationalization, most of the foreign investment in the Vaca Muerta came in the form of joint ventures with YPF.

Table 1: Foreign investment partners have proliferated in the Argentine oil and gas sector, but nationalized YPF remains the largest operator

Asset Type	Field	Oil or Gas?	Operator	Partner(s)	Discovery Year	Start-up Year	Shale Acreage (km2)	Resources (m bbl)	Production (k bbl/d)	Total CAPEX (m US\$)
Field	Loma la Lata-Sierra Barrosa	Oil	YPF	Chevron	2009	2010	32.4	9.4	2.0	-
Field	Loma la Lata-Sierra Barrosa	Oil	YPF	Chevron	2010	2014	44.5	14.0	3.5	-
Field	Loma Campana/Loma La Lata Norte	Oil	YPF	Chevron	2010	2011	388.5	1,424.3	34.5	426.4
Field	El Orejano	Gas	YPF	Dow Chemical	2011	2012	45.0	219.1	28.6	171.2
Field	Lindero Atravesado	Oil	BP	BP, Bridas Energy, CNOOC	2011	2012	127.5	1.6	0.1	10.0
Field	La Amarga Chica	Oil	YPF	Petronas	2011	2016	187.0	435.1	8.0	126.1
Field	Aguada Pichana	Oil	Total	Total, Wintershall Dea, BP, Bridas Energy, CNOOC	2012	2014	520.9	4.9	0.9	24.8
Field	Pampa de las Yeguas 1	Oil	Total	Total	2012	2012	521.0	21.6	1.9	72.0
Field	Aguada Pichana Este	Gas	Total	Total, Wintershall Dea, BP, Bridas Energy, CNOOC	2012	2014	761.0	237.0	9.4	41.3
Field	Bandurria Sur	Oil	YPF	Schlumberger	2012	2019		6.2	-	110.3
Field	Cortadera Block	Gas	Madalena Energy	Madalena Energy, Hidenesa SA	2016	2020	501.8	0.1		-
Field	Aguada Pichana Oeste/ Aguada de Castro	Gas	Pan American Energy	Pan American Energy, BP, Total, Wintershall Dea, Bridas Energy, CNOOC	2017	2018	768.0	141.2	4.3	85.9
License	Pampa de las Yeguas 1	Gas	YPF	ExxonMobil, Qatar Petroleum	2020	2022	1,036.0	78.2		-
License	Loma del Molle	Gas	YPF	ExxonMobil, Qatar Petroleum	2021	2023	1,036.0	78.4		-
License	Bajo del Toro	Oil	YPF	Equinor	2022	2029		7.3		0.1

Source: Rystad UCube

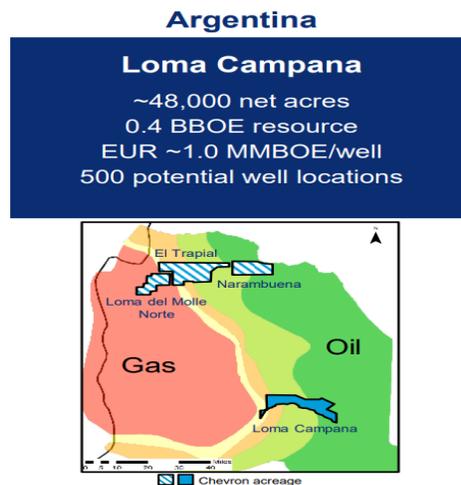
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YPF is leading development of Vaca Muerta with an expanding web of joint ventures (see Table 3). YPF’s first partnership was its 2013 deal with Chevron. The Argentine producer then announced further ventures with Dow Chemical Co.’s Argentine subsidiary, Shell, ExxonMobil, Equinor, and Schlumberger. Further foreign investment has either been forthcoming or announced by France’s Total SA, Germany’s Wintershall, Brazil’s Petrobras, Malaysia’s Petronas, the Italian-Argentine Tecpetrol, and Argentina-based Pan American Energy, majority owned by BP.³⁷

Chevron

The flagship IOC in Argentina is California-based Chevron. In 2013, YPF procured \$1.24 billion in investment commitment from Chevron to develop oil production on a pilot project 5,000-acre section of the 96,000-acre Loma Campana block, with YPF designated as the venture’s operator.³⁸ Total investment on the project was \$1.5 billion.³⁹ In 2014, Chevron decided to move ahead with a \$1.6 billion investment into production on the full Loma Campana block.⁴⁰ Oil production at Loma Campana reached 35,000 barrels of oil equivalent per day (boe/d) in 2017, allowing Chevron to begin recouping its investment outlays. Chevron said it expected to drill up to 70 horizontal wells into the field in 2019.⁴¹

Figure 5: Chevron’s exploration and production blocks in the Vaca Muerta



Source: Chevron 2019 Investor Presentation⁴²

In 2014, Chevron agreed to invest \$140 million in a second exploratory joint venture with YPF on a Vaca Muerta prospect called Narambuena. By 2019 it had agreed to two further pilots, agreeing to drill some 2,000 wells on 162,000 acres in the Vaca Muerta.⁴³ Despite these announcements, Chevron’s share of daily production in Argentina was just 20,000 barrels in 2018. The company in 2019 said it remained in the “early stages” of development in Argentina, given that infrastructure and market development was still in its infancy. The California-based supermajor mentioned that pipeline takeaway capacity remains limited in the Neuquén, although Chevron holds a 14% interest in an

oil pipeline between Neuquén basin and Buenos Aires.⁴⁴ Whether or not Chevron was going to move to full scale development outside Loma Campana remained uncertain, probably awaiting the outcome of the October 2019 election.

Royal Dutch Shell

Royal Dutch Shell has operated in Argentina since 1914 as a fuel retailer and, intermittently, as oil exploration and production firm. Shell's most recent exploration of Argentine shale began, like Chevron, in 2012. In 2018, the Netherlands-based company announced it would pursue a pilot investment into the Vaca Muerta, leading operations in five exploration blocks in which it purchased 35-year concession agreements, as well as holding stakes in four others.⁴⁵ While production was just 12,000 boe/d in 2018, it was expected to reach 40,000 by 2020 and up to 70,000 boe/d by the mid-2020s.⁴⁶ In 2019, Shell announced it would move ahead, promising to invest \$3 billion in its blocks over five years.⁴⁷

For Shell, the quick decline rates and short-cycle investment pattern of shale limited the company's risk exposure, helping increase its comfort in the risky political landscape in Argentina. "It insulates you. If the politics aren't great you can pull back. When things improve, you can drill more," said Laurens Gaarenstroom, Shell's country manager for Argentina until 2019. "The same thing goes for expropriation risk. It's really about how much capital I've got employed in the country. You can write off these wells after two years. There's no incentive for the government to expropriate."⁴⁸

Recent changes to Argentina's hydrocarbon laws also helped. "We actually started working with (Former President) Cristina (Fernández de Kirchner)," Gaarenstroom said. "They made some changes to the hydrocarbon laws that are good for the oil industry. So even if a populist government comes back, it would probably do everything possible to keep Vaca Muerta going. We all realize we're in this together. We're all trying to enlarge the ecosystem. That way the cost structure will come down and then Argentina is off to the races. Even if a populist government comes in they will recognize this. The last thing a government wants to do is expropriate. That will scare everybody away. Over the last 100 years they've been their own worst enemy."

ExxonMobil

Like Shell, ExxonMobil has a long history of intermittent involvement in Argentina. And, like Shell, the prospects of shale oil and gas from the rich geology in the Vaca Muerta enticed the company to return and reinvest. Exxon kicked off a small-scale pilot exploration in 2010.

In 2015, the company agreed to a 35-year concession on the Bajo del Choique-La Invernada block. Exxon is the operator with 90% stake, shared with Gas y Petróleo del Neuquén's 10% interest, but Qatar Petroleum holds a 30% stake in ExxonMobil's total upstream affiliates inside Argentina. The company's six initial wells began producing,

sending oil and gas into production facilities, with the gas flow added to the Pacific Gas pipeline in 2017.

In 2019, Exxon said it was satisfied with the initial results and agreed to invest a further \$2 billion over five years and raise its employee numbers to 1,600. It plans to drill, frack and complete a further 90 wells in the formation which would allow it to produce some 55,000 boe/d within five years.⁴⁹

Exxon subsidiary XTO was described by analysts as the slowest mover in Argentina, with plans to drill the smallest number of test wells during its pilot phase.⁵⁰

Other Foreign Investors in Vaca Muerta

France’s Total, a longstanding operator in Argentina’s gas sector, has a 41% share in YPF’s Agua Pinchana field development, which launched its first development phase in 2017.⁵¹

Britain-based Phoenix Global Resources operates and owns 90% of the Mata Mora block. In 2019, the company purchased another 35-year concession, this time for the Puesto Rojas block.⁵²

Wintershall Dea and ConocoPhillips announced in 2019 that they will jointly develop the Aguada Federal and the Bandurria Norte block.⁵³

Canada based Madalena Energy owns a 35% interest in the Coiron Amargo block.⁵⁴

Discussion

The strong potential for a reprise of resource nationalism in Argentina provides a useful stress test for our hypothesis, that the short cycle nature of shale investment insulates it from political interference.

Several questions arise. First, for the government: Will the administration of President Alberto Fernández turn on the oil sector as a source of patronage funds? If so, will it attempt to change terms of concession agreements in the Vaca Muerta? Second, for the IOCs: Will IOCs continue to re-invest in drilling on their concessions? Or will they wait for clearer signals regarding natural resource governance and subsidy policy of the incoming administration? Will they pull out if contractual changes are imposed?

While shale’s attributes offer some insulation from political interference and expropriation, investment and output can still be undermined by economic policy. For instance, a government that restricted commodity or currency exports or fixed domestic prices for energy commodities at unattractive levels would discourage investment in drilling and completions required to maintain constant output.

If, in the future, foreign investment in Argentine shale were to decline, that fact alone would not necessarily undermine our thesis. It remains one of our arguments that the characteristics of shale allow companies to act in a nimbler fashion, investing when

markets and returns allow, and pulling back when circumstances change. However, our hypotheses *would* come under challenge were IOC investments to dry up without substantial changes to terms or prices.

It also bears mentioning that recent investment in Argentina differs from that during Repsol’s ownership of YPF, when it faced few geographic limits on domestic exploration. Repsol’s ownership of nearly all of YPF essentially removed a once-public asset from the hands of the Argentine public and shifted it to the shareholders of a Spain-based corporation. Such a shift presented an attractive target for a populist administration. The current FDI model differs substantially. Much of the investment takes the form of 35-year concession agreements for specific exploration blocks, which include joint venture partners, of which YPF is a major player.

Further, it is becoming increasingly apparent among Argentine political and union leaders⁵⁵ that the IOCs in Argentina have stakes in oil and gas geographies outside the country, with which the Vaca Muerta competes for investment. As an XTO Energy executive put it in July 2018 regarding its Vaca Muerta assets, “We are in a position within our company where we are competing for capital.”⁵⁶

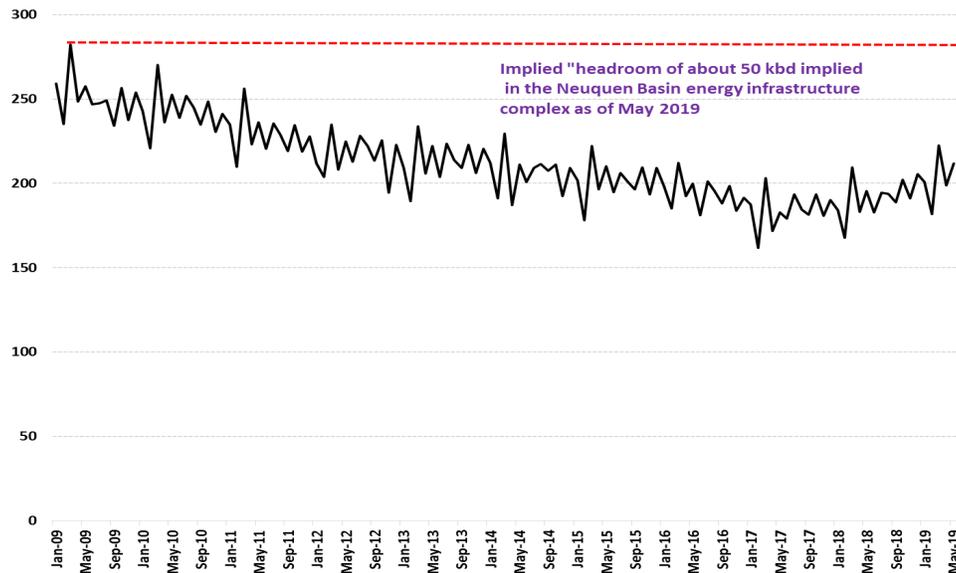
A shift to a resource nationalist footing in Argentina, all else constant, would serve to enhance the relative attractions of productive acreage elsewhere. IOCs could respond with more modest investments designed to maintain a foothold in Argentina, but at the same time reducing exposure to risk in the event of expropriation, the unilateral breaking of contracts or the implementation of price or currency controls.

As mentioned in the Box 2 above, political risk overshadows geology and most other factors involved in unconventional oil and gas developments because political factors cannot be financially hedged against, in the way that commodity prices can.

Cost control will remain important. Vaca Muerta developers will need to operate in a financially sustainable manner despite global oil prices that appear likely to track in a \$50-to-\$70 per barrel price band for several years to come. Operators must be able to access sufficient pipeline capacity to move their output to global markets. As the US Permian Basin experience has shown, takeaway constraints can badly disadvantage commodity prices, with crude oil in the geographical heart of the Permian at Midland selling for around two-thirds the price of oil at the Gulf of Mexico.

The Neuquén Basin has some degree of “headroom” or unused pipeline capacity, due to legacy oil development whose production steadily declined from 2009 to 2016, and then began recovering as Vaca Muerta development gained momentum (see Figure 7).

Figure 6. Neuquén Basin oil production trends since 2009 imply 50,000 barrels per day of unused pipeline capacity



Source: Energy Ministry of Argentina, author analysis

Conclusion

The rich hydrocarbon deposits in the Argentine Vaca Muerta appear to the world's oil and gas firms like the visions of a gold-rich El Dorado in a previous age. This time the "black gold" is technically accessible, but protected by an ingrained political and institutional culture of resource nationalism, which proved virulent enough to thwart the objectives of one international oil company in 2012. The political leader who authored that expropriation has just returned to a position of power in 2020, as the vice president and de facto leader of the Argentine Senate..

In the interim, more than a dozen international oil companies have invested in Argentina, purchasing concessions in the Vaca Muerta and engaging with local partners in drilling and production activities that have further characterized the bountiful nature of the geological resource.

Are we seeing the unfolding of latest bout of frustration, a reprise of the failed endeavors of foreigners to capture a share of Argentina's natural wealth? Or are investors willing to enter and remain in a politically unstable country with macroeconomic troubles, but abundant natural resources and rich geology? These questions provide a natural social science experiment, results of which will become clearer as 2020 unfolds.

Our examinations of the distinct nature of shale investments offer reason for cautious optimism. Oil and gas output from shale wells declines at a far faster rate than that of conventional wells. Continuous investment is required into drilling and completions to maintain constant output. We believe these facets offer some protection to shale

investments, since a resource nationalist state could undermine its own flow of rents and royalties unless its national oil company was sufficiently capitalized and competent to take over the expropriated properties. Of course, the risk protections do not cover phenomena such as restrictions on currency repatriation or unprofitable pricing trends or policies.

Interviews with IOC executives and analysts back up our initial hypothesis regarding shale, but with a caveat. The protections from interference appear more robust in the case of shale oil than they do for shale gas. That is because Argentina has some pre-existing oil infrastructure including unused takeaway capacity. More generally, oil is less costly to store, transport and convert to usable products for export, requiring smaller investment into on-the-ground infrastructure that presents a potential target for expropriation. On a price per unit of energy basis, oil also tends to be more valuable than natural gas.

On the other hand, Argentina has a less developed gas market and infrastructure. An increase in gas production would require investment into on-the-ground infrastructure. Natural gas is more costly to store and requires asset-specific transport and distribution networks that must keep it enclosed within pipes that extend from the wellhead to the burner tip – or to multibillion-dollar plants that can liquefy it for seaborne transport or convert it into chemical form. The plants and infrastructure required for converting, marketing and exporting natural gas represent riskier investment prospects for foreign firms, whether from expropriation risk, perhaps from a future decline in natural gas inputs due to slipping production in the Vaca Muerta.

The factors shaping hydrocarbon investment in Argentina are far closer to the global norm than those in the United States. If IOC investment into Argentina -- and Argentina's oil output -- continues to rise, even in the face of a likely increase in state resource nationalism, the increase would comprise a watershed event for the global petroleum industry.

The insulation from political risk of shale oil would contribute to a new sense of reduced political risk in the global petroleum industry and perhaps encourage further investment into shale deposits outside the United States. That, in turn, would result in further geographic dispersion of the oil sector.

Further afield, a broader geographic diversification of oil production could portend difficulties in cartel-led supply management and price controls. While major OPEC states like Saudi Arabia would retain their current advantages in production costs, a proliferation of new "fringe" shale producers would imply an increased level of supply and – all else constant – reduced prices and producer rents.

Acknowledgements

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Endnotes

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⁵ Index of Economic Freedom, Heritage Foundation, 2019;

<https://www.heritage.org/index/country/argentina> (Scores below 60 = mostly unfree; below 50 = repressed.) Argentina ranking: #148 out of 186 countries. Total score 52.2/100 (below regional and world average); Business freedom score: 56.4/100; Investment freedom score: 55/100

⁶ Oil production from the Vaca Muerta lags that of US shale plays as well as two plays in Canada Montney (1556 kbd) and Cardium (154 kbd). Vaca Muerta output is just ahead of that of China’s Longmaxi shale (152 kbd). Rystad UCube 2019.

⁷ According to Rystad data, between 2000 and 2012, only 5.5% of the total investment by YPF (Repsol) in Argentina was dedicated to shale/tight oil.

⁸ Laurens Gaarenstroom, Shell country manager for Argentina until 2019 (retired), interview with Jim Krane, Houston, Dec. 13, 2018.

⁹ The extent to which this is realized will depend on a host of other economic and regulatory factors that can present obstacles to shale development, as outlined in Kenneth Medlock III, ““The Land of Opportunity? Policy, Constraints and Energy Security in North America,” CES Research Paper, 2 June 2014, <https://www.bakerinstitute.org/research/land-opportunity-policy-constraints-and-energy-security-north-america/>.

¹⁰ Of course, shale developments worldwide remain subject to environmental opposition, aside from gas flaring. So, those issues must also be addressed where they present.

¹¹ Moran (1974) applied the phenomenon to copper nationalizations in Chile, so resource nationalism is not unique to oil, although it generally applies to situations where there are large upfront fixed costs.

¹² For conventional field decline rates see, for instance: Höök M, Davidsson S, Johansson S, Tang X. 2014 “Decline and depletion rates of oil production: a comprehensive investigation.” *Phil. Trans. R. Soc. A* 372: 20120448. <http://dx.doi.org/10.1098/rsta.2012.0448>

¹³ Catherine Ngai, “Decline rates from maturing oil wells in the Permian are on the rise,” *World Oil*, 9 October 2018, <https://www.worldoil.com/news/2018/10/9/decline-rates-from-maturing-oil-wells-in-the-permian-are-on-the-rise>. Supporting data also available from authors’ private analysis of selected EOG Resources wells in Lea County, NM. Note that Argentine shale formations may yield declines different than those in New Mexico.

¹⁴ Kenneth Medlock III, ““The Land of Opportunity? Policy, Constraints and Energy Security in North America,” CES Research Paper, 2 June 2014, <https://www.bakerinstitute.org/research/land-opportunity-policy-constraints-and-energy-security-north-america/>.

¹⁵ See, for instance: John Aguilar, “In “new era” of oil and gas regulation, Colorado communities waste no time writing own rules,” *Denver Post*, 6 May 2019, <https://www.denverpost.com/2019/05/06/colorado-oil-and-gas-local-regulations-181/>

¹⁶ Ed Crooks, "Capital raising by US oil companies falls sharply," the Financial Times, 22 January 2019, <https://www.ft.com/content/0a18f0b0-1eab-11e9-b126-46fc3ad87c65>

¹⁷ Medlock (9)

¹⁸ Argentina is a presidential democracy with a directly elected president and a bicameral Congress where power between the two chambers is symmetric. The Argentine president is elected for a four year term with the possibility of running for immediate re-election once, after which time they need to sit out one presidential term prior to attempting to run again. The Argentine Constitution endows the president with substantial power, including the ability to veto legislation that can only be overridden by a two-thirds majority in both chambers of Congress as well as the ability to issue presidential decrees with the force of law, which can only be annulled by a vote in Congress. The Argentine Chamber of Deputies has 257 members who are elected for four-year terms from the country's 23 provinces and the Federal District (City of Buenos Aires) using proportional representation and closed party lists. One half of the deputies are renewed every two years, with each province renewing half (or the closest to half in the case it possesses an odd number of deputies) every two years. The Argentine Senate has 72 members who are elected for six-year terms from the country's 23 provinces and Federal District, with each district possessing three senators, and with eight provinces renewing their entire Senate delegation every two years. The senators are elected using an incomplete list electoral system and closed party lists, under which the party or alliance that wins the most votes elects two senators and the party or alliance that finishes second in the vote elects one senator.

¹⁹ In theory, the provinces are represented in the Argentine Chamber of Deputies in proportion to their population. However, as part of the transition from military to civilian rule in 1983 the outgoing military government modified the electoral code to mandate that every province receive a minimum of five deputies. In addition, while the seats in the Chamber should have been reapportioned following each decennial census, that has not occurred due to the strident opposition of a large majority of the Argentine provinces which would see their share of the seats drop and that of the gargantuan Province of Buenos Aires rise as the result of any new apportionment.

²⁰ For example the entire Vaca Muerta shale play is located within the boundaries of Neuquén and Río Negro, with the exception of one department (the Argentine version of a county) in Mendoza (Malargüe) and one department in La Pampa (Puelén).

²¹ The province of Mendoza accounts for most of the remaining production with 3% of natural gas production and 14% of petroleum production located in the province (almost exclusively in Malargüe). La Pampa hosts nearly all the remaining production (1% of natural gas and 4% of petroleum).

²² All Argentine provinces elect governors who serve four year terms as well as a provincial legislature (most unicameral, but some bicameral) where the legislators with one exception are elected for four year terms, with some provinces have a midterm renovation and other provinces renewing the provincial legislature in its entirety every four years.

²³ Governors' ability to manipulate the electoral calendars has become a powerful tool. While in 1983 and 1989 every single province ran provincial elections simultaneously with the presidential contest, over time governors tended to strategically detach or attach provincial and federal elections. In 2007, only eight of the 24 districts elected governors simultaneously with the presidential election. In 2011, only nine of the 24 districts held their gubernatorial elections concurrently with the presidential contest. In 2015, only 11 of the 23 districts held their elections concurrently with the presidential contest. The number dropped to four in 2019.

²⁴ Considerable scholarship has underscored the progressive denationalization of the Argentine party system over the past 30 years. Utilizing distinct theoretical arguments and empirical measures, this body of work highlights two divergent processes. One, parties' performance tends to vary considerably across districts. Two, the provincial branches of parties, and even political actors who have defected from the country's two traditional parties, tend to concentrate their activities in their territorial bailiwicks, and

therefore create electoral coalitions and fronts which often do not mirror national partisan alignments. Mark P. Jones and Juan Pablo Micozzi, "Argentina's Unrepresentative and Unaccountable Congress Under the Kirchners," in Moira B. MacKinnon and Ludovico Feoli, eds., *Representation and Effectiveness in Latin American Democracies: Congress, Judiciary and Civil Society*. New York: Routledge (2013, pp. 40-74); Ernesto Calvo, *Legislator Success in Fragmented Congresses in Argentina: Plurality Cartels, Minority Presidents, and Lawmaking*. New York: Cambridge University Press (2014).

²⁵ Carlos Tomada, Diego Schleser, and Matías Maito, "Radiografía de la Sindicalización en Argentina," Universidad Nacional de San Martín (2018)

²⁶ Mauricio Macri is the first democratically elected non-Peronist to ever complete his full term in office. But, even Macri's victory in 2015 was largely the result of a sharply divided Peronist Movement which ran three presidential candidates who combined garnered 60% of the vote (Daniel Scioli-37%, Sergio Massa-21%, Adolfo Rodríguez Saá-2%) in the first round. In 2011 there were also three Peronist candidates who combined for 67% of the vote, the victorious Cristina Fernández de Kirchner (54%), Alberto Rodríguez Saá (8%), and Eduardo Duhalde (6%).

²⁷ "Argentina upstream summary." Wood Mackenzie, October 2018.

²⁸ IHS Energy Insight, "The Vaca Muerta Insight Series."

²⁹ "Assessment of Continuous Oil and Gas Resources in the Neuquén Basin Province, Argentina, 2016." US Geological Survey, Washington, 2016; <https://pubs.usgs.gov/fs/2017/3025/fs20173025.pdf>; Also see: Tom Sanzillo and Kathy Hipple, "Financial Risks Cloud Development of Argentina's Vaca Muerta Oil and Gas Reserves." Institute for Energy Economics and Financial Analysis, March 2019; http://ieefa.org/wp-content/uploads/2019/03/Financial-Risks-Cloud-Development-of-Vaca-Muerta_March-2019.pdf

³⁰ Marcelo J. Garcia, "Argentina's Likely Next President Is Not a Populist. Don't Make Him One." *New York Times*, Aug. 21, 2019; <https://www.nytimes.com/2019/08/21/opinion/international-world/argentinas-likely-next-president-is-not-a-populist-dont-make-him-one.html>

³¹ Rystad UCube 2019. See also: "Plan de Acción e Inversiones a Ejecutar," Ministry of Energy of Argentina, 2019; <http://datos.minem.gob.ar/dataset/plan-de-accion-e-inversiones-a-ejecutar-tablas-dinamicas>; Also: Natalia Kidd, "Vaca Muerta shale formation could be key to Argentina's economic development." *Agencia EFE*, July 4, 2019; <https://www.efe.com/efe/english/business/vaca-muerta-shale-formation-could-be-key-to-argentina-s-economic-development/50000265-4016180>

³² Jonathan Gilbert, "The Dead Cow Finally Produces Oil, a Century After Its Discovery," *Bloomberg News*, June 25, 2019, Online edition, <https://www.bloomberg.com/news/articles/2019-06-25/the-dead-cow-finally-produces-oil-a-century-after-its-discovery>. Also: Jonathan Gilbert, "Argentina Pursues \$5 Billion LNG Project Amid Political Havoc," *Bloomberg News*, Sept. 4, 2019; <https://www.bloomberg.com/news/articles/2019-09-04/argentina-pursues-5-billion-lng-project-amid-political-havoc>

³³ James Bambino, Charles Newbery, "Argentina's shale oil production growth pushes up refinery run rates." S&P Global/Platts, July 17, 2019; <https://www.spglobal.com/platts/en/market-insights/latest-news/oil/071719-argentinas-shale-oil-production-growth-pushes-up-refinery-run-rates>

³⁴ Charles Newbery, Buenos Aires correspondent S&P Global, interview with Jim Krane, Dec. 5, 2018.

³⁵ Kupchella and Cortez interview 2018.

³⁶ Charles Waine, "Economic Crisis Threatens to Stall Vaca Muerta," *Petroleum Economist*, May 14, 2019, Online edition, <https://www.petroleum-economist.com/articles/upstream/exploration-production/2019/economic-crisis-threatens-to-stall-vaca-muerta>.

³⁷ Tom Sanzillo and Kathy Hipple, "Financial Risks Cloud Development of Argentina's Vaca Muerta Oil

and Gas Reserves.” Institute for Energy Economics and Financial Analysis, March 2019; http://ieefa.org/wp-content/uploads/2019/03/Financial-Risks-Cloud-Development-of-Vaca-Muerta_March-2019.pdf

³⁸ “Argentina upstream summary.” Wood Mackenzie, October 2018.

³⁹ Morgan Stanley Research, “Argentina Shale: YPF’s Vaca Muerta: Alive and Kicking!”

⁴⁰ “Chevron, YPF Continue Development of Vaca Muerta Shale in Argentina,” Chevron (press release) April 10, 2014; <https://www.chevron.com/stories/2014/q2/chevron-ypf-continue-development-of-vaca-muerta-shale-in-argentina>

⁴¹ Chevron 2019 Investor Presentation, slide 18; <https://chevroncorp.gcs-web.com/static-files/ae79ba45-f861-45c0-9d5b-70e1ffab1f28>

⁴² Ibid.

⁴³ Christopher Lenton, “Chevron Announces Vaca Muerta Pilot as Argentina Natural Gas Market Develops.” *Natural Gas Intelligence*, March 5, 2019; <https://www.naturalgasintel.com/articles/117620-chevron-announces-vaca-muerta-pilot-as-argentina-natural-gas-market-develops>

⁴⁴ “Argentina,” Chevron website (undated); <https://www.chevron.com/worldwide/argentina>

⁴⁵ “Argentina,” Shell Oil (United States: Undated); <https://www.shell.us/energy-and-innovation/shale-gas-and-oil/where-we-operate/argentina.html>

⁴⁶ “SHELL ARGENTINA ANNOUNCES DEVELOPMENT DECISION FOR VACA MUERTA BLOCKS,” Shell (press release), Dec. 27, 2018; <https://www.shell.us/media/2018-media-releases/shell-argentina-announces-development-vaca-muerta-blocks.html>

⁴⁷ Agencia EFE

⁴⁸ Laurens Gaarenstroom, Shell country manager for Argentina until 2019 (retired), interview with Jim Krane, Houston, Dec. 13, 2018.

⁴⁹ “ExxonMobil proceeds with Argentina expansion project in Vaca Muerta Basin,” ExxonMobil press release, June 11, 2019; https://corporate.exxonmobil.com/news/newsroom/news-releases/2019/0611_exxonmobil-proceeds-with-argentina-expansion-project-in-vaca-muerta-basin; Santiago Spaltro, “ExxonMobil invertira US\$2000 millones en Vaca Muerta.” *El Cronista* (Buenos Aires), June 12, 2019; <https://www.cronista.com/apertura-negocio/empresas/ExxonMobil-invertira-us-2000-millones-en-Vaca-Muerta-20190611-0009.html>

⁵⁰ Amanda Kupchella and Maria Cortez, Wood Mackenzie, interview with Jim Krane, Dec. 4, 2018.

⁵¹ “Argentina: Total sanctions the development of Vaca Muerta shale resources and increases its participation,” Total SA press release, April 27, 2017; <https://www.total.com/en/media/news/press-releases/argentina-total-sanctions-development-vaca-muerta-shale-resources-and-increases-its-participation>

⁵² <https://www.bnamericas.com/en/news/phoenix-global-resources-completes-mata-mora-wells>

⁵³ https://www.rigzone.com/news/conocophillips_bringing_knowhow_to_vaca_muerta-25-jul-2019-159405-article/

⁵⁴ <https://www.marketwatch.com/press-release/madalena-announces-vaca-muerta-drilling-commencement-in-coiron-amargo-sur-este-block-2019-05-13>

⁵⁵ In discussions with Baker Institute fellows during two Argentine delegation visits to Houston in 2019

⁵⁶ Statement of James Blaine, Project Executive, International Ventures, XTO Energy, Stephen Rassenfoss, “Argentina’s Shale Play is Beginning To Live Up to Expectations,” JPT, July 2018, Pages 44-45