The Journal of Development Studies

ISSN: 0022-0388 (Print) 1743-9140 (Online) Journal homepage: http://www.tandfonline.com/loi/fjds20

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To cite this article: A. Patrick Behrer, Dale T. Manning & Andrew Seidl (2017): The Impact of Institutional and Land Use Change on Local Incomes in Chilean Patagonia, The Journal of Development Studies, DOI: 10.1080/00220388.2017.1385766

To link to this article: http://dx.doi.org/10.1080/00220388.2017.1385766

Published online: 18 Oct 2017.

The Journal of Development Studies, 2017
https://doi.org/10.1080/00220388.2017.1385766

ARTICLE

The Impact of Institutional and Land Use Change on Local Incomes in Chilean Patagonia

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(Original version submitted July 2016; Final version accepted September 2017)

ABSTRACT *Many developing rural economies depend on natural capital stocks for generating income and wealth. However, common property natural resources are often over-exploited. One method of solving over-exploitation is privatisation of the resource. In Palena, Chile, the privatisation of common-property grazing land facilitated a change in land use from grazing to tourism activities. We present a theoretical model that demonstrates that privatisation that leads to land use change has the potential to increase local wages. To resolve theoretical ambiguities, we calibrate a local general equilibrium model and find that privatisation and a switch to tourism resulted in higher wages in the local economy of Palena. This finding contributes to the ongoing investigation of the local costs and benefits of resource privatisation in developing countries.*

Introduction

There is mounting evidence that natural capital plays a significant role in generating income (Barbier, 2015) and supporting rural livelihoods (Billé, Lapeyre, & Pirard, 2012; Hamilton, 2006; Jarvis et al., 2011). In many cases, access to natural capital is mediated through land access, which can help mitigate poverty and support incomes in poor households (Finan, Sadoulet, & De Janvry, 2005). Despite the importance of land in developing countries, informal institutions and insecure property rights often lead to inefficient land uses (Goldstein & Udry, 2008). While evidence has emerged that communal natural resource management can conserve resource stocks and support local incomes (Ostrom, 2010), success is far from guaranteed. Therefore, in many cases, institutions that resemble privatisation can improve the value of natural capital assets, including land. Theoretically, resource privatisation improves total resource value (Weitzman, 1974) but the debate remains open about how labour incomes change as a result (Baland and Bjorvatn, 2013.).

In this paper, we develop a calibrated, local general equilibrium (GE) model to investigate the wage impacts of property rights and land use change in Chilean Patagonia where a private tourism company purchased common property grassland previously used by local populations as grazing land. When used as grazing land, the grassland existed in a degraded state because of poor ranching practices and a lack of management. Despite this, many local ranchers benefited from access to the land. With the arrival of the tourism company, the land became privately owned, with rents accruing to an outside owner. We ask how the change in land use affected local incomes. Importantly, the local community

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did not receive compensation for the privatised land. While our analysis focuses on the direct and indirect impacts of replacing common property land with a privately owned protected area, the lessons for the wage impact of privatisation with land use change can apply in other settings.

Given the over-exploited state of the grazing commons, economic theory indicates that privatisation should lead to a reduction in its use. This can reduce economy-wide labour demand and push wages down across the economy (Samuelson, 1974; Weitzman, 1974), especially in the short-run. In the specific case of Palena, Chile, however, the change in management regime facilitated a shift in land use, from a consumptive land use (grazing) to a non-consumptive use (ecotourism). This type of land conversion can benefit local labour if the non-consumptive activity is labour intensive and/or if the recovery of resource stocks is sufficiently high. A priori it is unclear whether local incomes should increase or fall as a result of the change in land use that occurred with privatisation. It should be noted, however, that an increase in labour demand is not guaranteed with a shift in management regime or land-use.

Our theoretical GE model demonstrates that privatisation and land use change can allow local incomes to increase across the local economy. Empirical results suggest that transitioning from grazing to non-consumptive ecotourism increased the demand for labour across the economy in this specific setting, raising low-skilled wages in all sectors. Further, in Palena wages increased even when the additional rent from privatisation was paid to investors outside the local economy. In this case, we find that the rent collector is 'worthy of his full-hire' (Samuelson, 1974). Importantly, these results provide evidence that privatisation and land use change can increase local wages but this result is not guaranteed and depends on the labour intensity of the new land use.

A local GE model is particularly well suited to investigate economy-wide impacts of resource management. In remote, rural economies, economic linkages form through endogenous prices and wages. These linkages transmit direct economic impacts in one sector throughout the local economy (Filipski & Taylor, 2012; Thome, Filipski, Kagin, Taylor, & Davis, 2013) and are key for determining equilibrium economy-wide earnings. For example, Manning, Taylor, and Wilen (2014) use a general equilibrium model to test if economic development outside a resource sector has the potential to reduce pressure on the resource as the opportunity cost of resource collection becomes higher. When resource prices are endogenous, increased demand for the resource can counteract the higher opportunity cost.

The results presented here advance the literature in three ways. First, they provide an additional case in which privatisation benefits local labour as land use changes. In regions like Palena, a movement towards high-value, non-consumptive resource use can improve local welfare, even if it requires outside resource ownership and investment.[1] Increased local labour demand, enabled by privatisation, can compensate for the loss of income from grazing and other traditional activities. Second, they offer relevant lessons for land managers in the developing world. If privatisation results in changing land use, it can increase earnings across the economy if it involves investment in labour-intense activities that use local labour. In these circumstances, improving natural capital value can complement local earnings. In the context studied here, allowing the land to recover meant that natural capital stocks were sufficiently high that even with private ownership, and subsequent rent leakage, local labour incomes increased. Finally, our results provide further evidence that resource management regimes have consequential impacts on natural capital use and human wellbeing in the developing world (Guerry et al., 2015).

In the following, we describe our empirical context and present the literature on privatisation, land use change and local incomes. Then, we develop a theoretical model to help formalise the interactions between management regimes, land use and economy-wide steady-state incomes. The primary implication of the model is that economy-wide steady-state labour wages do not necessarily fall because of land privatisation. The theoretical ambiguity is tested using a calibrated, stylised GE model. Finally, we discuss results and conclude.

Background

Palena, Chile is a small village in northern Patagonia approximately six miles from the border with Argentina. Set in the Rio Palena glacial valley and surrounded by multiple 6000 foot (~1800 meter)

peaks, the town (‘*comuna’*) is considered 100 per cent rural (Estadísticas, 2002). The region is remote, with road access arriving only in the 1980s. The town had a population of 1632 in ~500 households in 2012 with an average annual income of 427,000 Chilean pesos (~$700 USD). Poverty is common in this region with nearly 60 per cent of families receiving subsidies from the government (Delgado, Sepúlveda, & Marín, 2013) and the infant mortality rate at 8.9/1000 births (MDS, 2014). In the town of Palena, 62 per cent of non-governmental jobs are in the agricultural or forestry sector (CASEN, 2009). Within the agricultural sector, 58 per cent of the activity is in cattle ranching, followed by sheep ranching (BCN, 2012). There is no crop production reported in the region.

In addition to the importance of natural capital, Palena was selected as the location for the study because of a unique conservation project that occurred there. In 1997, a private Chilean/American conservation organisation, Patagonia Sur, purchased 7000 acres of land outside the village from the central government that had previously been used as common rangeland by ranchers in the area. Patagonia Sur transformed the newly private property into a subscription-based tourism operation, employing local community members as guides and labour on the property. This unique conservation project makes Palena an ideal example to better understand how land use change enabled by privatisation can influence local wages.

There is a rich economics literature on the management of natural capital stocks such as land (Dasgupta, 2007, 2008). When a resource stock is over-exploited, optimal management requires reducing extraction effort and harvest so that the resource stock recovers. As the resource stock grows, collectors (or owners who charge for use) earn a rent derived from the higher resource stock. This creates an individual incentive to increase extraction effort but management prevents this. With renewable resource management, a new steady state with a higher resource stock (Clark, 1990) and a more efficient allocation of factors of production results. Nevertheless, the distribution of wealth in the economy may change.

While natural resource management can leave workers worse off by reducing economy-wide labour demand (Samuelson, 1974; Weitzman, 1974), evidence exists (Ostrom, 2010) that communities can manage shared resources successfully. Others have argued that resource growth over time prevents wages from falling. For example, Baland and Bjorvatn (2013) show that resource privatisation can benefit labour over time if discount rates are low and resource extinction would occur without management. De Meza and Gould (1987) present a similar argument in which higher resource stocks can increase the wage in an economy, though the result is not proven to be an economy-wide steady state. Finally, Hannesson (2010) points out that rent loss may not be the appropriate indicator to use to examine the costs of common property and shows that workers can benefit from privatisation even before rents are distributed.

The models mentioned thus far implicitly assume the productive use of a resource remains the same before and after privatisation. Gains in efficiency come from higher resource stocks and higher productivity of fewer inputs in the sector. This ignores the potential for a shift in land use, as occurred in the Palena case.

In some cases, it has been shown that land use depends on the management regime in place. For example, land remaining in forest can be used for non-timber forest products and can help smooth consumption across time (Pattanayak & Sills, 2001) or timber can be sold to resolve short-run liquidity constraints (Jayachandran, 2013). A lack of property rights could encourage land conversion through excessive clearing (Ferretti-Gallon & Busch, 2014). Alternatively, the creation of property rights could encourage land use change as private property ensures a return to investment in agriculture (Liscow, 2013). In all cases, it is clear that the resource use is not independent of the management regime.

The literature on freeriding on the commons offers a potential mechanism explaining why privatisation can result in land use change (Cherry, Cotten, & Jones, 2013). Privatisation can facilitate the collection of rent over time, allowing for returns to investment that enables optimal use of the land. With shared property and freeriding, the returns to investment may be dissipated among many users, regardless of whether they contributed to the initial investment. There is, of course, no guarantee that privatisation will result in land use change and the results discussed here would only transfer to those settings in which there was such a change.

Apart from debate in the economics literature on the impact of privatisation, the role that private protected areas (PPAs) play in the mission to conserve global biodiversity has been discussed extensively in the biological conservation literature. PPAs are especially relevant to the debate over whether protected areas should focus only on biodiversity conservation or if protected areas should focus on both economic development and biodiversity conservation (Brechin, Wilshusen, Fortwangler, & West, 2002; Miller, Minteer, & Malan, 2011; Oates, 1999; Vaccaro, Beltran, & Paquet, 2013; Wilshusen, Brechin, Fortwangler, & West, 2002).

Driven largely by the growth of eco-tourism, PPAs may provide a new mechanism for connecting conservation to local economic benefits. In Chile there is evidence that they have increased local employment opportunities (Corcuera, Sepulveda, & Geisse, 2002).

In spite of the anecdotal evidence that parks – often through eco-tourism – can increase local incomes, there remains little economic examination of this question (Taylor, Dyer, Stewart, Yunez-Naude, & Ardila, 2003). Among the work that has been done, two related studies (Taylor et al. [2003] and Taylor, Hardner, & Stewart [2009]) are notable for taking a similar approach to this paper. Both utilise a local general equilibrium model to examine the impact of eco-tourism in the Galapagos. They find that while tourism has the potential to increase local incomes, inflows of labour from surrounding communities erase the gains over time on a per capita basis. They suggest that if these results hold universally, they pose a significant challenge to conservation based on eco-tourism operations.

Our model differs from these in two key respects. First, because of the isolation of the community studied, labour does not move into the local community and we assume full employment at the time of privatisation. Chilean census data indicate that the population in Palena has not increased since the privatisation event studied. We present robustness checks that incorporate upward sloping labour supplies. Secondly, our model focuses on land use change from common-property grazing to private tourism. Previous models focus on the growth of an existing tourism industry, rather than a transition to the new activity.

Theoretical model

We develop a stylised, two-sector theoretical model that demonstrates the economy-wide impacts of privatisation that enables land use change. Next, we calibrate a six-sector general equilibrium model to the local economy of Palena and find that incomes likely increased in practice. We also show that, consistent with Weitzman (1974), if privatisation had not led to land use change, economy-wide wages would have fallen.

Model setup

The stylised model is based on the model developed in Weitzman (1974), but with more than one potential land use. Weitzman (1974) formally proves the result that privatisation with no land (that is, property) use change lowers economy-wide wages. Samuelson (1974) demonstrates the same result. Therefore, we build on this conventional result to show that allowing for land use change can produce an outcome with either lower or higher wages.

Assume the economy has $\bar{L}$ units of labour to be allocated between using a stock of land (L_1) and another sector (L_2) such as local services (note that labour is equivalent to the 'variable factor' in Weitzman [1974]). Let steady-state output from the land be:

$$y_1 = f(L_1; x_{CP}) \tag{1}$$

where $x_{CP} > 0$ is the common property steady-state land quality. $f_L > 0$ and $f_{LL} < 0$. As discussed in Weitzman (1974), decreasing returns to land can occur because of congestion and/or because the steady-state resource quality lowers as labour increases.[2] The land quality, x, evolves according to the equation of motion:

$$\dot{X} = G(x) - f(L_1; x) \tag{2}$$

where $G(x)$ is a concave, stock-dependent growth function with a maximum at x^m. Because f represents bioeconomic steady states, $\dot{X} = 0$ at all points on the resource production curve.

Other-sector production is given by: $y_2 = g(L_2)$ with $g' > 0$ and $g'' \leq 0$. Assuming full employment in the economy $L_1 + L_2 = \bar{L}$. At equilibrium with common property land, the value marginal product of labour in the other sector equates to the value of average product on the commons. This is consistent with Nash competition with a large number of resource collectors (Brooks, Murray, Salant, & Weise 1999). Let p_1 and p_2 be the exogenous price of output in the two sectors. At the steady state, homogeneous labour in the economy allocates across the sectors such that

$$\frac{p_1 f\left(L_1^{CP}; x\right)}{L_1^{CP}} = p_2 g'\left(L_2^{CP}\right) = w_{CP} \tag{3}$$

where w_{CP} is the endogenous wage that clears the labour market when the land is common property. This market clearing condition is equivalent to that used in Manning, Taylor, and Wilen (2016) to describe the general equilibrium market failure given a common property resource. While the model developed in Manning et al. (2016) has two non-resource inputs, the only other input in the common property sector in our model is labour. Therefore, all value generated by the common property land resource is collected by labour. In this case, the average value of labour in ranching equates to its marginal value in other sectors.

Combining condition three with $L_1 + L_2 = \bar{L}$ produces the common property labour allocation, L_1^{CP} and L_2^{CP} as well as the economy-wide wage, w_{CP}. At this allocation, land rent is completely dissipated.

Representing the growing ecotourism industry (Wahnschafft and Le Blanc, 2013), there also exists an alternative use of the land where output is given by:

$$y_1' = h(L_1; x) \tag{4}$$

with an output price p_1'. We assume that with degraded land, the tourism activity is less valuable such that $\frac{p_1' h\left(L_1^{CP}; x_{CP}\right)}{L_1^{CP}} < \frac{p_1 f\left(L_1^{CP}; x_{CP}\right)}{L_1^{CP}}$. This implies that:

$$p_1' h\left(L_1^{CP}; x_{CP}\right) - L_1^{CP} w_{CP} < p_1 f\left(L_1^{CP}; x_{CP}\right) - L_1^{CP} w_{CP} = 0 \tag{5}$$

At x_{CP} tourism is less valuable than ranching so there exists no incentive for individual resource collectors to switch to the alternative use of the resource. Even if tourism could be valuable at x_{CP}, resource collectors may not switch if realising that value requires coordinated capital investment (Bchir & Willinger, 2012; Cherry et al., 2013; Janssen, Anderies, & Joshi, 2011). It is possible, however, that when a single owner maximises rent in the resource sector, as the resource stock recovers:

$$p_1' h\left(L_1^*; x^*\right) - L_1^* w^* > p_1 f\left(L_1^*; x^*\right) - L_1^* w^* \tag{6}$$

where stars indicate the optimal steady-state allocation of labour in the economy and $x^* > x_{CP}$. In this case, the private owner may let resource stocks recover and switch to the tourism activity.[3] The private resource owner equates the value marginal product of labour to the economy-wide wage such that:

$$p_1' h''\left(L_1^*; x^*\right) = p_2 g'\left(L_2^*\right) = w^* \tag{7}$$

While others have included the biomass in the tourism demand function (Abbott & Wilen, 2009), we include biomass in the tourism production function and interpret output as the tourist experience from

visiting Palena. Modelling tourism demand as a function of biomass would result in qualitatively similar results to those presented here. The tourism company invested heavily in both built capital improvements to the purchased land as well as programmes (for example, reforestation) that accelerated the natural recovery of biomass.

Privatisation and wages

We now explore the relationship between w^* and w_{CP}. First, we look at the case where land use remains the same before and after privatisation. In this case, the model developed here is consistent with the model developed in Weitzman (1974). When output prices are fixed and the technology remains the same in a resource sector, Weitzman (1974) proves that $w^* < w_{CP}$. This occurs because $f(L_1; x)$ is concave in L_1. This means the marginal product is less than the average product, or $p_1 f'\left(L_1^{CP}; x\right) < \frac{p_1 f\left(L_1^{CP}; x\right)}{L_1^{CP}}$. In other words, the privatised labour demand curve is everywhere below the common property labour demand. The lower demand for labour with a fixed (or upward sloping) supply unambiguously translates into a lower wage. Figure 1 illustrates shifting from common property to private land. As in Weitzman (1974) and Samuelson (1974), initial economy-wide labour wages are determined by labour's value of average product (VAP) on the land. When the land is privatised, landowners hire labour until its value marginal product (VMP) equates to the wage (shift 1) and economy-wide wages shift down (2) to w^*. We refer to the movement from average product to marginal product in the resource sector as the efficiency effect of land privatisation, which unambiguously decreases wages (for a full explanation and formal proof of this, see Weitzman [1974]).

If, on the other hand, land use change results from privatisation, the wage impact becomes less straightforward because the relationship between the common property and privatised demand for labour cannot be proven. As a result, when land use changes, the relationship between w_{CP} and w^* is ambiguous. This type of ambiguity is common in general equilibrium models that have potentially counteracting market effects (Manning et al., 2014). Because the labour supply and output prices are assumed constant, the impact of privatisation on the wage depends only on how the demand for labour changes in the economy. The efficiency effect shown in Weitzman (1974) remains but because the production function can change, a 'land use' effect also affects the wage. The sign of the land use effect depends on the nature of labour productivity in the new land use and can reinforce or counteract the efficiency effect.

To illustrate the drivers of this ambiguity, imagine two hypothetical cases. First, assume that privatisation results in complete land preservation, requiring no labour. In this case, the change in land use could further

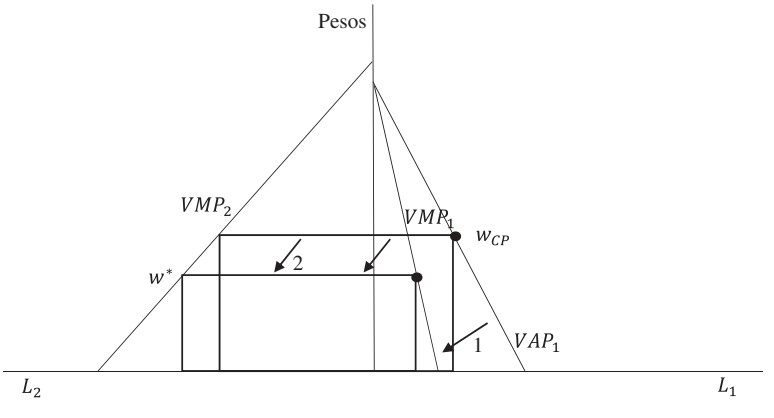

Figure 1. Privatisation leads to declines in labour income.
Notes: Initially, the economy-wide labour wage is set by the value of average product of labour in the common pool resource (w_{cp}). When this resource is privatized labour wages are set by the value of marginal product (shift 1). This causes economy-wide labour wages to fall to w^* (shift 2).

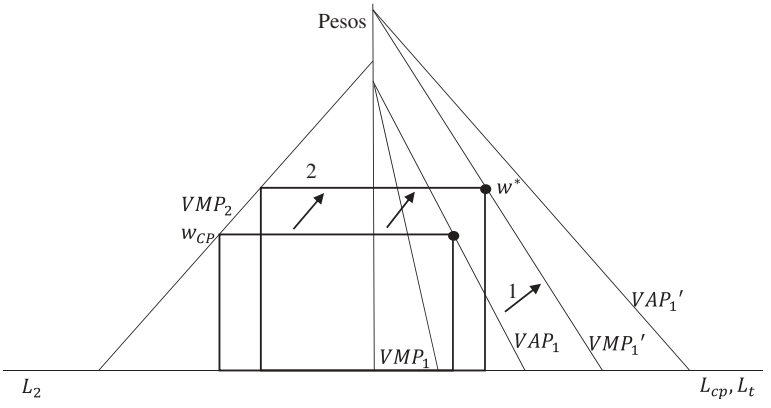

Figure 2. Labour incomes increase with privatisation.
Notes: As in Figure 1, economy-wide wage is initially set by the VAP of labour in the common pool resource (w_{cp}). With privatisation, however, the resource is used in a new activity where labour is paid its VMP in the new activity. Here we show the case where the new activity is more productive than the existing one. So there is a shift (1) from the low VAP to the higher VMP and a subsequent shift in economy-wide wage from w_{cp} to w^* (2).

exacerbate the decrease in economy-wide demand for labour, leading to further decreases in the wage. In other words, the efficiency and land use effects work in the same direction. On the other extreme, imagine that the privatised land use is very labour intensive (for example, labour-intense production or service-related tourism). This could increase the economy-wide demand for labour relative to the common property grazing case, leading to higher wages. When the new land use is labour intensive, the land-use effect counteracts the efficiency effect and could dominate, leading to an increase in wages.

More precisely, the net impact of the efficiency and land use effects determines the impact of privatisation on the wage. Specifically,

$$w^* >(<)\ w_{CP} \text{ as } p_1' h'\left(L_1^*; x^*\right) >(<)\ \frac{p_1 f\left(L_1^{CP}; x^{CP}\right)}{L_1^{CP}} \tag{8}$$

In general, the relationship between $p_1' h'\left(L_1^*; x^*\right)$ and $\frac{p_1 f\left(L_1^{CP}; x^{CP}\right)}{L_1^{CP}}$ depends on the functional forms specified for f and h. For example, if the new land use is labour intensive, the value marginal product of labour would be high, leading to high labour demand. For labour markets to clear (with fixed supply), this would result in higher wages relative to the case in which the new land use demands little labour. Figure 2 illustrates the case where the land use effect dominates the efficiency effect and privatisation increases the wage.

As seen in Figure 2 privatisation increases wages at the steady state if labour is highly productive in the new privatised activity. Because of the theoretically ambiguous impact of privatisation on wages in this context, we now turn to an applied example to test which of these effects dominates in a specific application.

Empirical application

Data

To test the impact of privatisation and land use change in Palena, we calibrate a stylised local GE model to data from the Los Lagos region of Chile. We call our model a stylised GE model because we lack detailed microdata for the Palena village. Instead, we downscale detailed regional data using rich local surveys conducted by the Chilean government that include information about the size of specific industries in Palena but not detailed information about economic flows in the village. Such a stylised

model is representative of both Palena and other remote regions in Patagonia that are dependent on ranching as their sole or primary source of income.

We choose to use a GE model, rather than a partial equilibrium model, because we are interested in the impact of wage changes not only in the old common resource ranching sector and new tourism sector, but across the whole economy. Using a GE model allows us to capture these effects while accounting for both direct and indirect impacts of privatisation and land use change (Taylor & Filipski, 2014; Taylor et al., 2016). A partial equilibrium model would not capture the effect on labour throughout all sectors of the local economy. Specifically, this analysis focuses on the region around the village of Palena.

The data used to calibrate the model come from national accounts data held by the Central Bank of Chile (BCC). Because the national accounts data are recorded annually at a regional level, we downscale the regional data using local level information on households and businesses, as in Filipski, Manning, Taylor, Diao, and Pradesha (2013). We start with the BCC data and use *comuna* level reports from the Chilean Library of Congress (BCN) to identify the economic sectors in the regional accounts that are present in Palena (Bcn, 2012). This takes account of the differences between Palena and the Los Lagos region as a whole (for example, Los Lagos has many miles of coastlines and Palena is far inland). We then downscale the remaining sectors and household consumption based on the population of Palena relative to the population of Los Lagos reported in the 2002 census conducted by the Chilean National Institute of Statistics (INE). We verify that the population for Palena is consistent with the population in survey data from the Ministry of Social Development (MDS) in 2010 and 2011 (Mds, 2014). We also use the MDS data, which reports employment and enterprise counts by sector in Palena in 2010 and 2011, to verify that our downscaling results in output shares that are consistent with reported employment and enterprise payment shares.

These data are similar to the US Census data. The MDS data come from biannual or triennial surveys conducted to understand the characteristics of poverty in Chile. These data are collected by sending surveyors to private homes around the country and could be compared to the American Community Survey data in the US context. These data were supplemented by meetings with employees of Patagonia Sur to obtain secondary company financial data used to represent the tourism sector in Palena.

We assume constant production technologies across the region to obtain input-output coefficients for intermediate inputs and for labour and capital per value of output from the regional data. This process gives us the output of each sector present in Palena as well as the intermediate input consumption for each sector (including from external and government sectors).

These data are aggregated into a social accounting matrix (SAM) that represents the flows of money through the village in 2007 (for SAM see Appendix 1). In addition to the five industries (Private Ranching, Industry, Tourism, Services and Retail) in the village, the SAM includes a government and an external sector. The only agricultural products reported in Palena fall in the ranching sector so there is no separate crop production sector. Common property ranching was not observed in the 2007 data but will be included as an additional (sixth) sector that uses common property land. Labour is divided into skilled and unskilled and is owned by the representative household. Ownership of physical capital resides either with the household or, in the case of private tourism land, with the external tourism operator. Labour is mobile between sectors of the local economy while capital and land are fixed to a given activity. Land ownership depends on the model scenario. In the case of common property ranching, it is assumed the household owns the land but receives no rent payments; the value produced by land is collected by labour in the sector. When labour collects the land value, the marginal product of labour in other sectors exceeds its marginal product in ranching. Calibration of the common property ranching sector, not included in the 2007 data, is discussed in detail below. In the case of private land ownership, the tourist operator, who resides outside the local economy, collects the factor payments to land and biomass. Further, in the simulations that have both private and common property ranching, the output of these two sectors is aggregated and this aggregated total is used in measurements of exports and market clearing conditions. We do this because it is assumed that the cattle produced by each sector are indistinguishable in the market.

After compiling the data into the village SAM, an RAS procedure (Schneider & Zenios, 1990) is used to balance all accounts.

Applied GE model

The data from the SAM is imported into GAMS (General Algebraic Modelling System) and used to calculated a general equilibrium model of the Palena economy.[4] Cobb-Douglas production functions are assumed for all sectors with Leontief coefficients for intermediate inputs (Manning et al., 2014; Taylor & Adelman, 2003). A government sector taxes and provides subsidies to the region. Finally, a representative household maximises a Cobb-Douglas utility function, which is parameterised using expenditure shares from the village SAM. This household provides labour to the production sectors and consumes both locally produced and imported goods. Tourism, private ranching, industry and common property ranching both import and export goods so prices are set exogenously while wages are endogenous. The service and retail sectors have endogenously set value-added prices and wages, though many of their intermediate inputs (for example, retail purchases from industry) have exogenous prices. This is consistent with a setting in which isolated service and labour markets exist but goods can be transported between the local economy and the rest of the world. While Palena imports and exports production output, it is sufficiently remote to make the total labour supply plausibly fixed. Thus, in our base calibration, the total labour demanded across all six sectors (plus government) must equal the fixed labour endowment of the representative household. We relax this requirement in subsequent runs of the model and allow for an increasing labour supply as the labour wage increases.[5] The household faces a budget constraint that the value of imports cannot exceed the value of exports (Taylor & Adelman, 2003).

All private sectors in the economy are calibrated using observed payments to factors of production, quantities produced and quantities consumed. The value marginal product of all inputs equates across all private sectors. The calibrated model exactly replicates the data in the SAM.

As is conventional in the local general equilibrium model literature (Taylor & Adelman, 2003), we assume constant returns to scale in all production sectors. At the same time, the amount of land available for production in a given sector remains fixed. This means that, conditional on the quantity of land in production, there are decreasing returns to scale in other inputs, including labour. This is also true in other sectors where capital remains fixed and sector-specific.

The unique feature of this model is the existence of two potential uses of a given land endowment. Model parameters must be obtained for both common property grazing and tourism when only tourism is observed in our base data.

Tourism. In the private tourism scenario all of the parameters are observed (from in-person meetings with collaborators at the tourism company) and taken directly from the SAM. Under tourism, the land returns to its un-harvested state. The biomass carrying capacity per unit land is solved for by dividing the total payment to private land (observed in the SAM) by the number of acres used. This gives an implied biomass per acre for the steady-state carrying-capacity of the land that is consistent with observed levels in the region (Sánchez-Jardón et al., 2010). Importantly, biomass per acre determines the payments to land in this model. Biomass units are normalised such that the price of one unit of biomass across all acres equals one.

Common property ranch land. It is assumed that private and common property ranching production parameters do not differ and the sectors' output is the same product. Calibration uses observed payments to inputs, including land and biomass in private ranching. While common property ranching has the same production parameters as private ranching, the biomass level differs. Specifically, we assume that the number of acres, A, and biomass per acre, x, are substitutable. Therefore, the observed payment to land in the SAM is actually a payment to total biomass, which comes from biomass per acre and the number of acres. The Cobb-Douglas production function for grazing takes the following form:

$$y = TL^{a}(Ax)^{b}$$

where T measure total factor productivity and L is the quantity of labour. a and b are parameters to be specified. Given this specification, an increase in A or x increases grazing output. This could occur as cows are grazed over more land or as land has more biomass per unit area.

To calculate a payment to the privatised tourism land (7000 acres) if it had remained in common property grazing, A is fixed at 7000 acres and, X is solved for by assuming that biomass on the common property land is 4 per cent of the carrying capacity, as calculated from the tourism sector calibration. This choice was informed by conversations with private ranchers who recalled very low biomass on common property grazing land. The sensitivity of the results to this assumption are presented in Table 2 and discussed below. Finally, when grazing land is common property, the value marginal product of labour does not equate to the economy-wide wage. Instead, as in the theoretical section, labour enters the sector until the average product of labour equates to the wage. Table 1 summarises the production parameters used for the two types of ranching sectors as well as the tourism sector.

Table 1. Biomass calculation parameters

	Private Ranching	Common Property Ranching	Tourism	Source
Acres (A)	105,555	7,000	7,000	Bcn, 2012/Collaborators
Payment to Land Owner	$40,000	$0	$31,312	SAM
Revenue per Acre (x)	$0.37	$0.18	$4.47	Calculated
Percent of Max. Biomass	8%	4%	100%	Local Experts

Notes: We normalise prices to one so that payments to biomass equal the level of biomass on the land.

Table 2. Results of a shift in property rights regimes from common property to privatised land, per cent changes

	Initial Results		Single Labour Class Results		Sensitivity to the ratio of Common Property Biomass to Private Biomass		
	Tourism Case	Private Ranching Case	Tourism Case	Private Ranching Case	0.1	0.5	1
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Household Income	6.37%	−0.10%	5.69%	−0.05%	7.40%	6.37%	5.19%
Household Consumption							
Private Ranching	6.37%	−0.10%	5.69%	−0.05%	7.40%	6.37%	5.19%
Industry	6.37%	−0.10%	5.69%	−0.05%	7.40%	6.37%	5.19%
Services	1.35%	0.10%	1.78%	0.06%	1.32%	1.35%	1.39%
Retail	3.62%	−0.03%	3.37%	−0.02%	3.97%	3.62%	3.23%
Government	4.92%	−0.18%	0.63%	0.13%	5.67%	4.92%	4.07%
Wages							
Low-Skilled Labour	7.84%	−0.39%	5.43%	−0.21%	9.13%	7.84%	6.07%
High-Skilled Labour	1.08%	0.11%			1.26%	1.08%	0.85%
Exports	−0.07%	0.19%	−1.15%	0.26%	−0.82%	−0.07%	0.83%
Sectoral Output							
Private Ranching	−21.57%	7.59%	−18.10%	6.73%	−25.14%	−21.57%	−17.17%
Industry	−3.95%	0.04%	−11.22%	0.38%	4.68%	3.95%	3.07%
Services	−1.02%	0.12%	0.00%	0.00%	−1.04%	−1.02%	−1.01%
Retail	0.25%	0.04%	0.00%	0.00%	0.44%	0.25%	0.03%
Government	1.18%	0.01%	0%	0.00%	1.39%	1.18%	0.92%

Simulation

The model is solved under three cases to test the effects of land use and property rights regime on local wages. In the base case, the 7000 acres in question are assumed to be in common property ranching. The productive use of the land in this case is common property cattle ranching. Factor demand for labour is determined by the equivalence of the average product of labour in common property ranching with the economy-wide wage, similar to the condition described in Equation (3).

In our first policy simulation, we examine the impact of privatising the land and changing the use from cattle ranching to tourism. We call this the tourism case. The simulation is constructed by introducing tourism as a productive use in the model and removing common property ranching. The biomass level recovers to its long-term steady state and the value marginal product of labour equates across all sectors (note, this is the case calibrated from the SAM and this simulation exactly reproduces the base data).

In our second policy simulation, we again examine the impact of privatising the common property but do not allow the productive use to change. Rather, the privatised land remains in ranching. We change the newly privatised cattle ranching factor demand such that the marginal product of labour equates to the economy-wide wage. Biomass recovers to the levels observed on private cattle ranching land in Palena today (8% of carrying capacity). To maintain comparability with the tourism case, we assume that land rents accrue to owners outside the local economy.

As a robustness check, we run both the tourism simulation and the private ranching simulation without a distinction between high and low-skilled labour. All other parameters remain the same. We also run the same simulations but with a positive labour supply elasticity and examine sensitivity to this parameter (see Figure 3, discussed below).

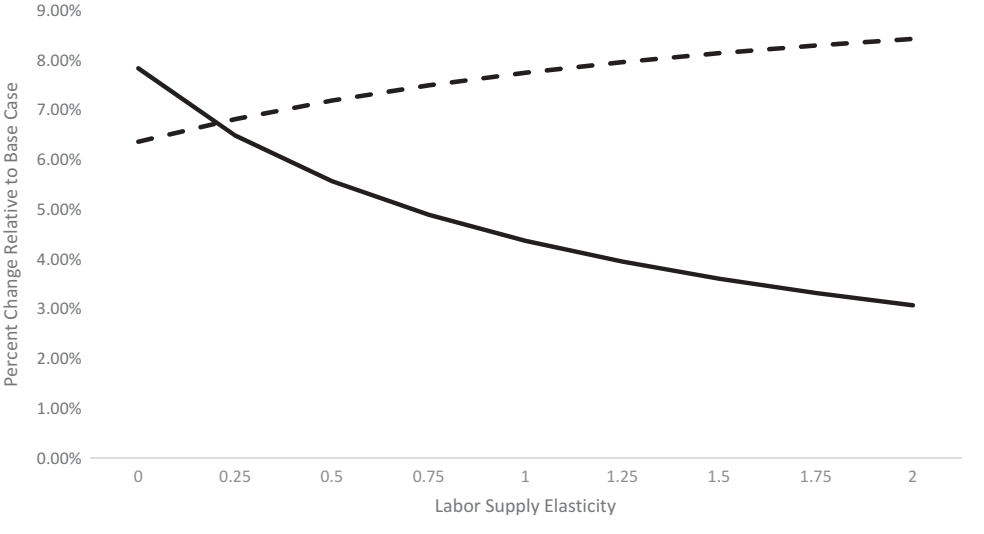

Figure 3. Change in household income and low-skill wages with positive labour supply elasticity.
Notes: Figure 3 shows how allowing a positive labour supply elasticity reduces the wage income impacts of transitioning from common property grazing to private tourism. In the initial simulation, with a labour elasticity of 0 such a transition leads to an increase in low skill wages of 7.84 per cent. As the labour elasticity approaches 2 these gains fall to near 3 per cent. Notably, even with labour elasticity of 2, which seems highly unlikely in the Palena context, there would still be noticeable benefits to low-skill labour after privatisation. The dashed line shows the change in household incomes. Because the household owns all labour in the economy as the labour supply increases, driving down the wage difference, overall household income increases as more units of labour earn more income.

Results

Table 2 shows the results of the simulated changes from the base case. In the tourism case, low-skilled labour incomes increase by 7.84 per cent relative to the base case. Overall, household income increases by 6.37 per cent in the tourism case and exports fall by 0.07 per cent. Private ranching output declines, as one would expect, with the increased cost of low-skilled labour. The higher price of labour inputs drives down the rental rate of the non-transitioning land. Labour in tourism is far more productive than in ranching. As a result, tourism employs more labour than common property ranching, pulling some labour from private ranching. Because no other sector exerts major demand on land in Palena (and tourism draws on the common property ranching land), the decline in ranching output places substantial downward pressure on land prices (wages) in private ranching. If the model allowed tourism to draw on all available land, one would not expect to see such a large decline in land prices as demand from the tourist sector would cause land to transition from ranching to tourism. The other sectors in the model also show decreased output as low-skill labour costs increase.

Taken together, our results provide evidence that privatisation and land use change in the context explored here caused local wages to increase, though at the expense of lower returns to capital and other land. This occurred because the new land use has a high demand for labour. To determine if this result would hold in other contexts, it is important to consider the labour intensity of the new land use in comparison to labour allocated to the land when it is common property. It is also important to consider if new labour demand would be met by local labour.

In our model, newly created rent is not redistributed locally. Rent generated from the private nature of the tourism operation accrues to the external tourism operator, not to local households. Thus, there is rent leakage from the local economy. As a result, the observed increases in income (Table 2, first row) are the result of wage increases and occur even without rent redistribution. In the scenario with all labour grouped together, it is confirmed that overall labour wages can increase with privatisation (Table 2, column 3).

These effects indicate that a shift from common property land to private ownership not only does not have to reduce labour incomes but can increase them if the shift in property rights regime induces a change in productive use. The overall increase in household income with land use change is expected – privatisation leads to an increase in economy-wide efficiency – but is notable because this increase in economy-wide income occurs even when the rents leave the local economy.

Next, we demonstrate that in the private ranching case, where land is privatised but the productive activity remains the same, shifting from common property to private ranching decreases labour wages in the steady state (Table 2, columns 2 and 4). Low-skill labour wages fall by 0.39 per cent when the land is privatised but the productive use remains cattle ranching, with a corresponding increase in the biomass levels to those found on private ranch land. This is consistent with the result from Weitzman (1974) and Samuelson (1974) and confirms that the critical feature of the tourism case is the change in land use that occurred with privatisation.

When we allow the labour supply to increase in response to higher wages, the results remain broadly consistent. Figure 3 shows that as the labour supply elasticity increases from 0 to 2 the increase in low-skill labour wage increases fall from 7.84 per cent to around 3 per cent. Notably, however, even when the labour elasticity is 2, households and low-skill labour still enjoy higher income and wages in the tourism scenario.

An important caveat to these results is that they are dependent on the stock recovery that results from tourism. Because tourism is a non-extractive use of the biomass on the land (natural capital), and the tourism operator in Palena has invested heavily in rebuilding the biomass stock, we assume that the steady-state level of biomass in the tourism case is near the maximum observed level of biomass for this type of land in this region of Chile (Sánchez-Jardón et al., 2010). The level of biomass on private ranching land implied by the data observed in the SAM

is assumed to be a fraction of this carrying capacity. Common property ranching has an even smaller biomass per unit land.

We believe that this is a reasonable representation of reality for two reasons. First, the maximum observed biomass reported by Sánchez-Jardón et al. (2010) is for land that is mixed woodland/grassland. That is an accurate characterisation of the land being used for tourism but grazing land typically has mainly grasses, which accumulate approximately one third of the maximum possible biomass in this region. Second, anecdotal evidence from former ranchers from Palena indicate that grazing land, both private and common-property, is typically over-grazed in this region of Chile. Thus, it seems reasonable that the level of biomass would be substantially below the carrying capacity.

Despite this justification for model parameterisation, we present our main results with various levels of biomass on the common property land in columns 5–7 of Table 2. The key results remain the same for common property biomass levels between 0.8 per cent and 8 per cent of carrying capacity.

Comparing the model results to anecdotal evidence from the region confirms the increase in local wages. While the tourism company has not explicitly measured the change in incomes over time, they have noted that incomes have generally improved since they began operations. Informal conversations with former ranchers now employed as guides indicate that their personal incomes have increased.

Policy implications and discussion

The localised general equilibrium approach used here demonstrates that in Palena the privatisation of common property ranch land and subsequent creation of an ecotourism destination increased local wages, particularly for low-skilled workers, when coupled with a change in land use, though it decreased returns to other land and capital. The specifics of the case presented here highlight the importance of considering the interactions between the management regime and the potential uses of a resource. In particular, non-consumptive uses of natural capital may be more productive than consumptive uses but require investment to be feasible. In these cases, management regimes, like privatisation, that enable the capture of rents over time can facilitate the investments that allow for a transition from low-value consumptive use to high-value non-consumptive use.

In the context of the debate over conservation methods, this result indicates that exclusive reserves could benefit local communities. In particular, the possibility exists for mutually beneficial relationships where an outside owner gains ownership of a resource in return for providing external knowledge of tourism operations that increase local employment opportunities. In the case presented here, local labour benefited even though they lost free access to the previously common property resource. This increase in wages was driven entirely by economic activity made possible by the exclusive reserve nature of the conservation project. These results make it clear that one cannot dismiss exclusive reserves as universally harmful to local incomes or welfare. However, it is not a general result that an exclusive reserve is better for local incomes than a reserve that provides tourism opportunities and grants some level of local access. It is still possible, but not guaranteed, that exclusive reserves lower local incomes.

While empirical results demonstrate that the representative household is better off with private land, the structure of the model ignores welfare impacts across different households. This simplification is made because of data limitations. Because we only include a single representative household we are unable to comment on the distributional impacts across different household types. We can, however, note that both high-skill and low-skill labour see an increase in wages in our base model. This indicates that households with both worker types can benefit from the land use change. Beyond the differential impacts on households based on their possession of high- or low-skill labour, there are also likely to be differences based on what

industry a household derives their income from. For example, households that are primarily engaged in retail may benefit disproportionately as demand for their retail increases with tourism. Alternatively, higher wages benefit labour but may hurt some business owners. A complete distributional analysis of the transition from common property to private ownership of a resource should include a consideration of these impacts. Doing so would require explicitly modelling several household types rather than a single representative household.

A further distributional consideration includes the use of rents generated from the privatised land. The generation of rents means that incomes could further improve with some rent redistribution. Combining local rent distribution with privatisation of common property resources can reinforce the income improvements shown here while mitigating losses to local owners of capital and land.

Finally, there are several important aspects of the approach taken here to keep in mind when interpreting these results. The first is the assumption that labour supply is fixed. Because of Palena's remoteness and general lack of economic opportunity this seems a reasonable assumption (our results are robust to relaxing the assumption as we discuss). Population in the village has actually declined over the last 15 years. Despite this, it is not the case in all tourist destinations that labour supply is fixed or declining. As Taylor et al. (2009) point out in the Galapagos, immigration can erase the benefits to local labour from increased tourism activity (and have detrimental environmental impacts).[6] A privatisation policy must carefully consider the labour mobility and wage endogeneity in a particular setting.

The second consideration is the dependence of this approach on the economic linkages as identified in the SAM. The relative productivity of each sector plays a large role in determining how factors are allocated in the economy and deviations from the assumptions made in the SAM could change both demand for factors and, as a result, their wages. Further, there may be barriers to movement of factors from one sector to another. We assume that capital is immobile – the capital needed in a retail operation is likely much different than that needed in a tourist operation – but labour is mobile. Certain jobs may require skillsets that are learned over time, making labour less mobile.

Of particular relevance is the different skill sets needed to be a rancher versus a tourist guide. While some workers may be able to make this transition (as has been the case in Palena), others may struggle. The more difficult it is for labour to transition, or to conduct the necessary training to allow the transition from one productive sector to another, the less beneficial the transition in productive use will be. In the extreme, if ranchers are completely unable to transition to tourism, then changing grazing land to tourism centres may make the former ranchers strictly worse off as new labour is imported to serve as tour guides and former ranchers continue to work in low-productivity sectors.

Finally, as the local economy becomes more service-oriented, reduced local food production could lead to a higher price and harm net consumers of food. In our base model, we assume integrated food markets, allowing imports to compensate for reductions in local production.

In light of these concerns, the results here should be taken primarily as a stylised illustration of the theoretical model laid out above. They do not indicate that similar privatisation exercises in other communities will have the same benefits. Rather, they confirm empirically that privatisation of common property land could improve labour incomes, regardless of the distribution of rents, if that privatisation leads to a change in the productive use of the land. This result has important implications for the use of PPAs to conserve valuable natural land and habitats. If PPAs commit to hiring local labour, they can promote conservation while positively impacting communities by supporting labour wages across the local economy.

Conclusion

In this paper, we demonstrate that resource privatisation does not always lower wages in an economy. Specifically, we show that – independent of the distribution of newly created rents – land privatisation

can improve labour wages if that privatisation leads to a shift in the productive use of the land. In other words, if labour is highly productive in the new land use, labour wages can improve after privatisation. This is important because it demonstrates that labour wages can improve in the absence of redistributionist policies or any labour rights to the newly created rents.

It is important to note, however, that these qualitative results do not hold in general. It is theoretically possible for labour demand in the new land use to be lower than in the common property activity. In that case, wages likely fall with privatisation. The role of biomass stocks in resource production influences the net impact of privatisation. New productive uses that generate high stock levels and lead to higher labour productivity are more likely to result in higher wages.

One context in which these results may be particularly useful is in the development of conservation reserves. These results demonstrate that it is possible for a conservation reserve to benefit a local community even if that community loses their traditional level of access to the resource. Private conservation reserves could incentivise investment in tourism activities that require labour as an important input. If the new reserve attracts tourists who value the conserved resource, this could provide sufficient employment opportunities for the local community to offset the lost income from a common property resource property regime. It should be highlighted, however, that this is not true in all cases. The empirical example here relies heavily on high-end tourists willing to pay a premium and the fact that wages are endogenous. Whether the results hold elsewhere depends on conditions in those localities. Our results are most likely to generalise to other localities like Palena, a community whose isolation has resulted in extremely well-preserved scenic and cultural heritage that tourists are willing to pay a premium to access but whose isolation limits in-migration.

In general, these results highlight the importance of considering the wider impacts of property rights regimes when analysing the effects of changing them. Property rights regimes may have a direct impact on the way in which a resource is utilised, not only on the intensity at which it is utilised. This means that the full effects of a property rights change cannot be captured by simply moving from a fixed marginal product to average product of labour. Rather, it suggests that a local general equilibrium approach which measures the effects of a shift in the productive makeup of the local economy can more accurately capture the full effects of the property rights change.

The growing interest in natural capital accounting makes taking a holistic view of property rights and land use even more important. The same natural capital stocks are likely to have very different values to a community depending on the property rights. It is established that weak property rights make it difficult to capture value from a given level of natural capital stocks. Our results indicate that strengthening property rights has the potential to make capturing existing value easier for those endowed with the new property rights without hurting labour in the local economy. That implies that the private returns to the natural capital stocks underestimate their true social value.

Possible extensions of the current analysis include an examination of these effects in locations where the new productive use is something other than tourism. A more explicit bio-economic examination of the role that resource stocks play would also be informative. Finally, examining these effects in a dynamic model – rather than one based on steady state levels – could endogenise optimal production activities while revealing effects on labour during the transition period between common property and privatised resource uses.

Acknowledgments

We would like to thank Patagonia Sur, LLC for sharing their data and answering questions about their operations in Palena. We'd also like to thank Harvey Cutler for helpful feedback on previous versions of this paper. Finally, the participants of the Heartland Environmental and Resource Economics Workshop 2014 provided helpful comments on a poster version of this paper.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes

1. Note that privatisation may not always be necessary to realise many of the gains we show here. One could imagine that a long-term rental agreement between Palena and Patagonia Sur could have yielded many of the same benefits. However, these results are indicative that privatisation is not *always* bad for local labour wages.
2. This production function can be shown to represent steady states of a bio-economic model with Schaefer production and logistic natural resource growth.
3. The dynamically optimal resource use depends on the single owner's discount rate. Also, a single owner would not face the coordination problems that would hold up investment in the case where investment, rather than stock recovery, was the obstacle to tourism.
4. All GAMS code and data used for this analysis can be made available upon request.
5. Allowing for an increasing labour supply can be thought of as representing immigration, an increase in the labour supply due to underemployment in the base condition, or both.
6. It is worth noting that, measured by travel time, Palena is more remote than the Galapagos Islands. The Galapagos Islands are roughly a three-hour flight from Ecuador's capital. Reaching Palena from Chile's capital requires a three-hour flight followed by an 8–10 hour drive on primarily gravel roads.

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Table A1. Palena SAM

Millions of Chilean Pesos														
	Private Ranching	Indust	Tourism	Services	Retail	Government	Household	Labourlow	Labourhigh	Physcap	Biomass/ Land	Land	External	Total
Private Ranching	92.355	72.406		1.599	3.45	0.514	39.227						207.147	416.70
Indust	72.403	92.478		196.93	51.624	15.492	349.726						694.155	1472.81
Tourism													165.695	165.70
Services	133.809	171.128	14.806	427.997	117.538	37.134	1325.913						363.128	2591.45
Retail	30.178	28.255		128.929	42.608	6.499	437.25						135.716	809.44
Government	21.968	68.66	8.294	106.338	40.205	312.438	182.689						7.998	748.59
Household								1008.568	469.405	840.562		16.271		2334.81
Labourlow	37.76		44.15	898.666	27.992									1008.57
Labourhigh		51.139		42.444		375.822								469.41
Physcap		95.283	35.785	573.567	135.236	0.691								840.56
Biomass/ Land[a]			22.341											22.34
Land	28.225													28.23
External		893.459	40.319	214.984	390.781						22.341	11.954		1573.84
Total	416.70	1472.81	165.70	2591.45	809.43	748.59	2334.81	1008.57	469.41	840.56	22.34	28.23	1573.84	

Notes: [a] Becomes the input to common property ranching under simulation.