Mexico: Estimation of the Economic Opportunity Cost of Capital for Public Investment Projects

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Executive Summary

This report presents a new estimation of the economic opportunity cost of capital (EOCK) for public sector projects in Mexico. Following an introductory background section, part 2 discusses the methodology adopted in this report, namely the weighted cost of capital approach. In section 3, we review the methodology and rates of return proposed for Mexico in 2009 by Sergio L. Rodriguez-Medrano for the years 1970 to 2006. According to Rodriguez's calculations, the economic opportunity cost of capital comes to approximately 12 percent. Adding to his analysis, we recreate the necessary database to extend the results to the year 2012. Furthermore, because the 2009 study did not include the contribution of domestic savings, we add a simulation to explore its inclusion based on reasonable assumptions. In this scenario, we conclude that the EOCK for an average public sector project would be about 10 percent in 2012. We then expand on these results and provide a more detailed analysis of the macroeconomic, labor, financial, and tax information to re-estimate the *top-down* (weighted cost of capital approach) EOCK for Mexico, arriving at a value of about 10.4 percent. In part 4, we estimate the EOCK using the *bottom-up* (supply price plus externalities) method, not only to confirm the results obtained in the previous section, but also to provide additional insights regarding this alternative approach. In our conclusions, we recommend a single discount rate or EOCK for public sector projects of 10 percent. A separate annex section includes the estimation, a short discussion of the potential impacts of the proposed 2013 fiscal/tax reforms on the EOCK, and other relevant materials.

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1 Background and significance of the economic opportunity cost of capital (EOCK)

The official discount rate that informs decision making on investment options—known as the social discount rate or the economic opportunity cost of capital (EOCK)—is critically important to policy makers. The EOCK is an economic price for the valuation of savings and investments and their contribution to economic production in the coming years. Investment projects use a combination of inputs or real resources (such as land, labor, and capital) to produce outputs that society is willing to pay for, whether directly or indirectly. Taking this into consideration, the EOCK is used as a hurdle rate to determine the desirability of implementing projects.

In Mexico, the current official discount rate for public sector projects is 12 percent in real terms. To assist in the public investment decision-making process, the Mexican finance ministry (*Secretaría de Hacienda y Crédito Público* or SHCP) uses a benchmark real discount rate to assess economic cash flows and to estimate the net benefits of alternative investment proposals (DOF, 2012). This official rate and methodology is correspondingly utilized by all public sector agencies in Mexico whose project proposals are approved by the investment unit—*Unidad de Inversiones*—of the SHCP. The 12 percent discount rate adopted by the *Unidad de Inversiones* was underpinned by the findings of a study conducted by Sergio L. Rodriguez-Medrano (2009).

In view of significant macroeconomic developments in recent years, the Mexican government has requested the World Bank's assistance in reviewing the current economic opportunity cost of capital and the methodology used for its estimation. In place for a considerable period of time and backed by the Rodriguez 2009 study, the EOCK of 12 percent was estimated using a version of the weighted cost of capital approach (Harberger, 1972b). However, in the last few years, Mexico's credit rating has improved considerably, resulting in a lower cost of equity. This technical review of Mexico's EOCK takes into account the recent improvements in the country's economic and financial structure as well as in the international capital markets.

The objective of this study is to review the EOCK for Mexico and the methodology employed for its computation. The findings of this study provide the basis for a new recommended discount rate to better inform the Mexican government in the selection of public sector investment projects. In addition to updating and expanding the current methodological approach through a detailed analysis of the 2003–2011 period, we propose an enhanced methodology to estimate Mexico's EOCK going forward.

Our principal recommendation to the Mexican government is a significant downward adjustment of the EOCK—specifically, we recommend adopting a single value EOCK that could be reduced to 10 percent, allowing for some flexibility with higher risk investments. In high-risk cases such as market-oriented public projects or large commercial public-private partnerships (PPPs), the Mexican government might consider using a higher discount rate, which could be assessed using the supply price approach discussed in this study. The high-risk distinction could be particularly important for companies like PEMEX, as well as utilities and infrastructure projects that depend on user fees to cover investment costs. In the Mexican context, the data shows that the presence of PEMEX—a large public sector corporation that produces output and is also heavily taxed—significantly affects the SHCP's determination of the appropriate discount rates.

We also recommend that the EOCK be regularly updated. Over the medium term, the EOCK is expected to experience upward pressure, as monetary supply restraints are restored in the capital markets in the coming years and as Mexico seeks enhanced revenues to stabilize its fiscal position. However, the EOCK could also experience downward pressure if improved governance and economic reforms further reduce the country risk premiums in the capital markets. In this report, we offer a preliminary assessment of the impact the recently approved fiscal reform on the EOCK is likely to have. Nevertheless, considering the hitherto uncertain effect of broader reform efforts in Mexico, we recommend reassessing the EOCK in five years.

2 Assessing the EOCK

This section describes the weighted cost of capital method used for the assessment of public sector projects and also discusses alternative methods that have been considered in the literature.

2.1 The weighted cost of capital method

The weighted cost of capital method is based on the assumption that the discount rate for capital investments should be the economic opportunity cost of funds obtained from the capital markets. This rate—initially proposed by Arnold C. Harberger (1972, 1980, and 1997) and subsequently expanded and improved by other authors—is a weighted average of the marginal productivity of capital in the private sector and the rate of time preference for consumption or the interest rate on savings.

The decision to fund a public project will displace private investments and consumption. The weights for the estimation of the EOCK, as explained in more detail below, will come from the expected displacement of investments in one case or the postponed consumption in the other, evaluated at their respective economic prices. A key advantage of the weighted cost method is the use of market information to estimate prices for the marginal gross of tax returns for investors as well as net of tax savings rates for consumers or suppliers of capital, both domestic and foreign. The basic equations underlying this method are summarized in Box 1.

Box 1: The weighted cost of capital

The economic opportunity cost of capital (EOCK) is the weighted average of the share of displaced investments (ω^d) priced at the gross of tax return (π) and share of induced savings ($\omega^s = 1 - \omega^d$) at the rate of time preference for consumption (r).

$$EOCK = \omega^d \pi + \omega^s r$$

For several types of investors and savers, the weighted returns can be expressed as follows:

$$\omega^d \pi = \sum_{j=1}^{n} \omega_j^d \pi_j = \frac{-\sum_{j=1}^{n} \eta_j^d (I_j / S) \pi_j}{\sum_{i=1}^{m} \varepsilon_i^s (S_i / S) - \sum_{j=1}^{n} \eta_j^d (I_j / S)} \text{ and}$$

$$\omega^s r = \sum_{i=1}^{m} \omega_i^s r_i = \frac{\sum_{i=1}^{m} \varepsilon_i^s (S_i / S) r_i}{\sum_{i=1}^{m} \varepsilon_i^s (S_i / S) - \sum_{j=1}^{n} \eta_j^d (I_j / S)} \quad \text{and} \quad \sum_{j=1}^{n} \omega_j^d + \sum_{i}^{m} \omega_i^s = 1$$

The weight of demand for displaced investments of type j (ω_j^d) is the elasticity of demand (η_j^d) times the investment share over total savings (I_j/S) for each type of investment. This weight is applied to the gross of tax return (πj) of the type j investment. Similarly, for the weight of supply of savings out of postponed consumption from type i (ω_i^s) is the elasticity of demand (ε_i^s) times the savings share over total savings for each group (i), times the net of tax returns (ri). This method will be shown in more detail in the next sections.

The weighted cost of capital approach offers certain advantages over alternative methods, particularly with regard to clarity and robustness of the results. It is a comprehensive approach that takes into account the impact of financing public projects on both domestic private investment and consumption, while other approaches tend to focus either on one variable or the other. Unlike alternative methodologies, the weighted cost of capital estimation is based on observed market evidence. For instance, this approach relies on domestic prices such that economic values are compatible with the values in financial flows and budget analysis. Furthermore, it favors the comparability of results across sectors in the economy, hence promoting transparency. Based on these characteristics, the weighted cost of capital methodology has been widely favored by governments and multilateral agencies (including the

World Bank). As demonstrated by Burgess (2008), the weighted cost of capital approach tends to offer a higher probability of optimal investment choices than other methodologies. For further discussion on the merits of this approach, see Rajaram et al. (2010).

2.2 Alternative methods to assess the EOCK

The literature offers several alternatives to the weighted cost of capital approach to estimate the EOCK. Below we offer a brief review of the following: (i) the social rate of time preference (SRTP) method; (ii) the marginal productivity of capital in the private sector method; and (iii) a method that uses an accounting or "sliding" discount rate. In addition, Annex 1 provides some simple examples to compare the weighted average approach with alternative methods.

The social rate of time preference (SRTP) measures the preference for giving up consumption in favor of savings. A method originally proposed by Marglin (1963), Feldstein (1964), and Dasgupta et al. (1972), the SRTP-based discount rate has become the preferred approach by some European countries (e.g. the United Kingdom) and European multilateral agencies. Often centrally prescribed rather than measured in the capital markets, the SRTP method still generates debate when compared to the weighted cost of capital approach. The latter was the chosen methodology in this report given its obvious advantages in the Mexican context, where the current discount rate is market-based and estimated using a weighted cost of capital method.

The SRTP could be comparable with the EOCK by valuing investment costs at the shadow price of investment measured in units of consumption. Conceptually, the SRTP must be used in discounting consumption benefits and costs measured in units of foregone consumption. Hence, to make the SRTP comparable to the weighted cost of capital method, investment costs should be valued at the shadow price of investment, which measures the foregone consumption arising from the investment. For a long-lived investment, if investment is financed out of a weighted average of foregone investment and consumption, then the shadow price of investment is the present value of the foregone stream of consumption, where EOCK/r = $\omega^d\,\pi/r + \omega^s$, or a

weighted average of the consumption foregone on investment valued at (π/r) consumption units and the share from consumption valued at unity. Clearly, the shadow price of investment rises with the investment share and the gap between π and r.[1] Relying on the shadow price of investment when using the SRTP will yield similar conclusions to those reached when using the EOCK.

The SRTP tends to be significantly lower than the rate obtained when using the weighted cost of capital method. In capital market terms, the SRTP can be equated to the rate of time preference for consumption (r), and hence, if the marginal economic product of capital (π) exceeds r, then the EOCK exceeds the SRTP. According to Lopez (2008), when taking into consideration the long-term horizons and environmental sustainability of public sector projects, the social discount rate for Mexico should be 3.3 percent.

Compared to the weighted average approach, which uses the domestic currency as the numeraire or unit of account, the use of the SRTP implies a loss of transparency and simplicity in accounting. The defenders of the SRTP method for discounting justify its use on the basis of normative prescriptions, which, as observed earlier, are not based on market transactions.

Another possible approach to assess the discount rate considers the marginal productivity of capital in the private sector. This approach is based on the principle that the government will always seek to maximize the returns to the economy. Under this rationale, all public sector projects would use the rate equal to the marginal productivity of capital in the private sector (Hirshleifer et al., 1960). If private sector returns are higher than the ones generated by the public sector, more funds should then be made available to the private sector to maximize the returns on economic resources. Little and Mirrlees (1969, 1974) developed a cost-benefit method that

[1] In countries with substantial taxes on capital (corporate, property, and personal income taxes), a large distortion can exist between π and r, such that the shadow price of investment (EOCK/r) can be around 1.5 to 2, making the adjustment to the appraisal significant.

values costs and benefits in terms of border or world prices in foreign exchange units.[2] This methodology recommends using the foregone economic return for the discount rate, which is an appropriate estimate in developing countries with effectively closed economies and weak domestic savings.

The marginal productivity of capital in the private sector method advocates the use of a discount rate based on the return on foregone investment (or π). This approach to setting the discount rate is appropriate in closed economies with unresponsive private savings. Under these conditions, the weighted average EOCK could be approximated by the value of the marginal economic product of capital (π) as ω^d approaches unity. In the context of more open economies with increasingly integrated capital markets, this extreme assumption is no longer appropriate. One possible advantage of this method is the comparability of projects across borders, as they are measured using international monetary units. Some international organizations and UN agencies have used this method in the past.

The discount rate based on the marginal productivity of capital in the private sector approach is higher than the weighted EOCK. An unnecessarily higher discount rate for public sector projects, as π is by definition higher than the weighted EOCK, can result in the elimination of worthwhile investments in the public sector, hence leading to real economic losses.

Finally, the accounting or sliding discount rate employs a rationing approach that allows public sector projects to be funded, in descending order, as long as there are available resources in the public sector budget. Originally proposed by Little and Mirrlees (1969, 1974) and by Squire and van der Tak (1975), this method recommends the use of an accounting discount rate, which is compared to the marginal returns from public sector projects, within the available budget constraints for the public sector. The accounting discount rate employs a rationing device to fund public sector projects in descending order, on the condition that the

[2] An attractive approach to dealing with the value of traded goods, the Little and Mirrlees methodology requires all non-traded goods and labor to be converted to their foreign exchange equivalent and all distortions are expressed in foreign exchange units.

marginal project (e.g. the one with the lowest economic internal rate of return or lowest net present value) is accepted subject to available resources in the public sector budget. The accounting discount rate is adjusted upwards or downwards depending on the proposed projects, their returns using this discount rate, and the budget.

From an economic standpoint, the accounting discount rate approach is not optimal. An accepted economic discount rate (as a true opportunity cost to the economy) ensures that only projects deemed to contribute to the economy at that rate should be adopted. Excess funds, if any, should then be used to lower the public sector debt and/or fund private sector projects through the private capital markets. By contrast, an accounting discount rate only selects projects appropriately if the selected discount rate is equal to or higher than the EOCK. When enough funds are available, the sliding rate advocates the approval of public sector projects that yield lower returns than those approved with the weighted EOCK, ultimately generating economic losses.

2.3 Suggested improvements to the weighted cost of capital method

Seeking to strengthen the traditional Harberger approach, this study takes into account recent advancements in the weighted cost method. First, we apply to each step of the methodology the latest innovations in the estimation of the EOCK components for the period 2003–2011. Second, our analysis provides further refinements to the weighted cost of capital approach, as well as examples to demonstrate the advantages that these improvements offer for decision-making purposes.

Empirical evidence showed that the traditional weighted average approach might present some challenges. Two significant problems in the traditional approach to the weighted average EOCK stand out: (a) differentials in the mobilization or intermediation costs of financing for certain types of projects that raise the real costs of supplying capital funds (for example, for

micro financed projects[3]); and (b) the differential costs of systematic risk (both country risk and market risk) that need to be recognized in different types of investment. To illustrate, consider that a public infrastructure project that depends on government revenue for financing ultimately faces lower risk-related costs than a project that is financed by market-determined revenues and, accordingly, bears the full or partial costs of market risk. Government decision makers face the challenge of appraising publicly financed projects as well as public sector market-oriented and market-financed projects, such as those undertaken by state-owned commercial enterprises, regulated utilities, and user fee–financed public private partnerships.

Nonetheless, the EOCK can be adjusted to address these challenges. For example, the EOCK can be adjusted down to a "risk-free" and "intermediation-cost-free" estimate, which may be appropriate for purely publicly financed projects. The EOCK, however, requires further adjustment in cases where significant mobilization of funding and systematic market risk costs arise. The alternative and more direct approach employed in this study begins by estimating the minimum financial supply price of capital to the investment project, then factoring in the economic externalities resulting from the use of capital funds. The externalities are a consequence of tax and other distortions that arise as the capital markets adjust to the use of capital funds through reduced investment and expanded domestic and foreign savings. This approach can offer greater precision and practicality in defining country, market, and project risk considerations, as discussed in greater detail below. The analysis also demonstrates that the enhanced methodology is consistent with the traditional EOCK approach (Glenday, 2010).

The supply price approach to the EOCK is based on the estimation of the minimum supply price of capital and on the estimation of the externalities arising in the economy from the use of capital. The minimum supply price in capital markets is the minimum cost of capital required by the financiers of the investment project in a competitive market. This minimum required rate of return would adjust for all the differential costs of risk and the capital mobilization costs that would either make the financiers indifferent between funding the project

[3] The cost of supply and administration of micro financed projects is much higher, given that the costs per unit of capital tend to be much higher.

and allocating the funds to alternative investments, or withdrawing their savings from the capital market and channeling the resources elsewhere. The minimum supply price of capital in the market implicitly captures all the compensating differentials for the specific project (due to location, project, and country risks) without an explicit need to analyze them and account for them. Given the general fungibility of funds over the long run, the externality[4] associated with the long-term investment of capital in an economy can be taken to be a function of the characteristics of the economy (such as the structure of taxation) rather than of the project itself, and hence, it is taken as a single estimate characteristic of the economy.

The externality per unit of capital invested over the long run can be thought of as a national parameter. This approach to estimating the EOCK captures the specific characteristics of the project being financed, as well as the general externalities arising from the long-run use of capital funds by the project in a particular country. Following the standard model of economic pricing, this method takes the financial price of a commodity and adjusts for the associated economic externality. For example, when estimating the economic opportunity cost of labor, the minimum market supply price plus externalities approach is applicable, as labor markets experience significant compensating differentials to adjust supply prices for job and location conditions.

The minimum supply price based EOCK allows to differentiate between pure public sector–financed projects and self-financing projects. Self-financing projects span different sectors of the economy and are characterized by added market risk costs to the financiers (market risk effects). The differentiation between publicly-financed and self-financed projects allows for explicit recognition of the externalities arising from the use of capital funds. As mentioned above, the EOCK consists of the sum of the financial prices paid by the project plus externalities per unit of capital. This is comparable to the economic price of foreign exchange in the economy, which is the market exchange rate plus externalities that result from taxes and subsidies in the relevant markets arising from the use of foreign exchange.

[4] This refers to the additional costs to society of investing in a project that are ***external*** to the calculations of the investors.

The minimum supply price based EOCK is consistent with the traditional approach. This can be readily shown by recognizing that the economic value of the marginal product of a unit of capital (π) is also equal to the weighted average cost of capital (i_m) plus the tax externalities (and any other externalities such as monopoly rents) per unit of capital (t_d) or $\pi = i_m + t_d$. A detailed explanation is offered in Annex II.

3 Empirical estimations: Application to Mexico

This section presents and discusses the application of the weighted cost of capital method to the case of Mexico. Section 3.1 considers the traditional approach, starting with an assessment of the applied methodology (Rodriguez, 2009), which covers the 1970–2006 period. The following section covers the recalculation of the 2009 study results, updating them to 2012. Section 3.3 offers a more detailed analysis of the top-down methodology to make explicit the necessary adjustments, based on market and economic information, to obtain rates of return and ultimately the EOCK.

3.1 Estimation of the traditional weighted average EOCK

3.1.1 The Rodriguez methodology and estimates

The Rodriguez (2009) estimation of the EOCK for Mexico focuses on the cost associated with the displacement of private investments and the role of foreign savings, while the cost of displacing domestic consumption is considered negligible on the basis of an assumed low or zero supply elasticity of savings. Relying on the weighted cost of capital approach, the Rodriguez study focuses solely on the cost associated with the displacement of private investment (gross of taxes) and the expansion of the foreign supply of savings. Displaced

consumption is excluded on the basis of the low elasticity of savings, which, according Rodriguez, reduces its influence on the EOCK.

The 2009 Rodriguez estimation of the return to capital in the private sector is based on a strong assumption on the treatment of labor income that affects the final estimation of the EOCK. The return to capital in the private sector is estimated using national account statistics and adjusted on the basis of a strong single assumption that labor income should be treated as part of the gross operational surplus. This adjustment to the capital income reflects the share of labor income earned in unincorporated activities that are reported as capital income in the national accounts. The study assumes that out of the gross operating capital profits for the private sector recorded in the national accounts, 50 percent can be attributed to labor. To reflect on this, consider that if the initial allocation of gross value added for labor is 33 percent and for capital it is 67 percent, by assuming that 50 percent of capital income is in fact labor income, the result flips to about 67 percent for labor and 33 percent for capital. It is this assumption that leads to the 2009 study results and the recommended EOCK of 12 percent for Mexico.

The following excerpt (Rodriguez 2009, 113–6) explains the basis for Rodriguez's recommendation of a <u>12 percent official EOCK</u> for public sector projects in Mexico:

> *The economic cost generated by the displacement of private investment captured by the economic return to capital in the private sector is defined as the ratio of the income from private capital gross of taxes to the private capital stock. . . .*
>
> *The information used to estimate the return to capital comes from the Mexican National Accounts. This data was adjusted in order to obtain a measure closer to the economic concept dictated by the theoretical framework. The most important adjustment refers to the treatment of the income from workers who do not receive an explicit payment, as may be the case for owners and family members; if not considered, this event artificially increases the reported income from capital, and hence, the estimated return to capital. On a first approximation, following Cervini (1995) and Jenkins (2003), it was assumed that the income from capital reported by the national accounts includes between 30% and 50% of labor income, although the "true" share may be closer to 50% than to 30%. . . .*

The estimated economic return on private producible capital, i.e. the rate of return that should be used to compute the EOCK, fluctuated between 14.7% in 1973 and 11.6% in 2002; the average return was 13.8% during the 70s and 12.2% during the 00s. These results correspond to the scenario with medium depreciation rates and 50% of the gross operational surplus attributable to income from labor.

The estimated MECFB [marginal economic cost of foreign borrowing] used in this study was, on average, 10.7% per year. . . . The average elasticity reported was −1.8 [demand for investment], while the share of foreign savings in net domestic investment was 26%.

Using the previous parameters, and assuming an elasticity of the supply of foreign saving equal to one, the EOCK for the Mexican economy was 13.5% in the 70s, 12.8% in the 80s, 12.9% in the 90s, and 11.8% in the 00s.

3.1.2 Updated analysis and commentary

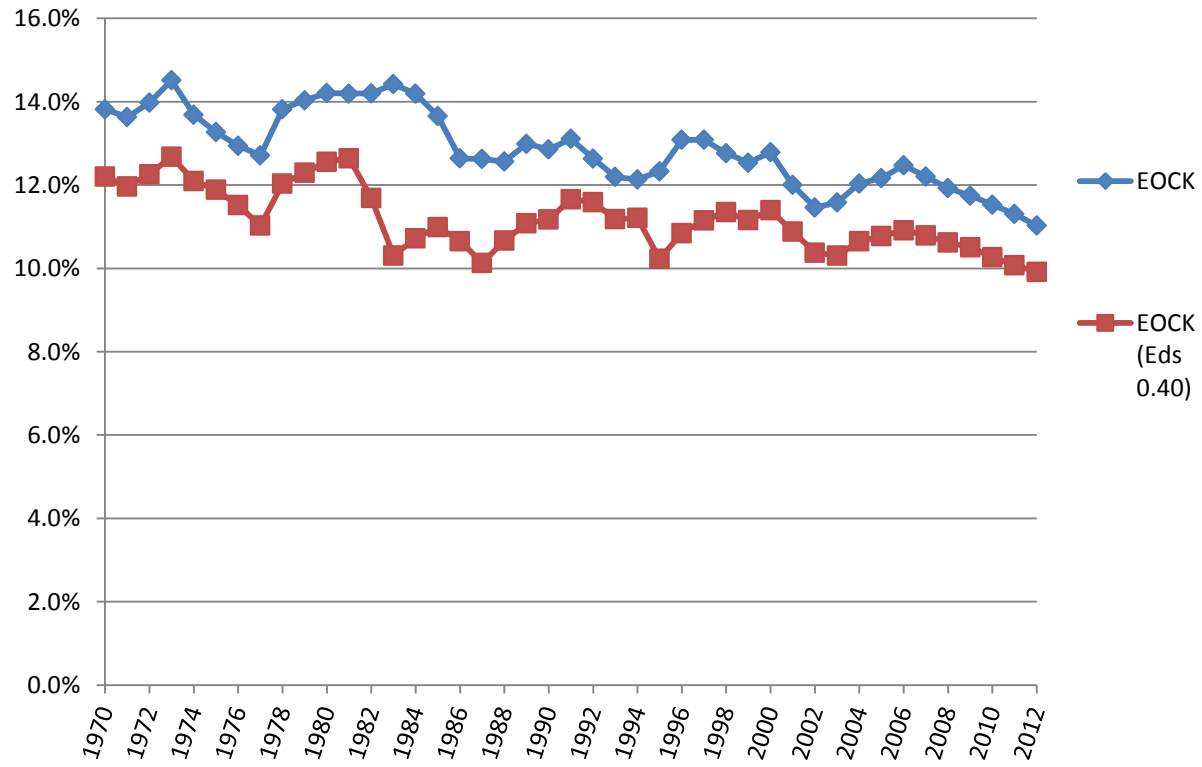
With the information provided in the Rodriguez (2009) study, we proceeded to recalculate a series of estimated values for the capital stocks, income to private capital, and rates of return to producible capital. We checked for consistency of the Rodriguez data and key results with more recent national accounts data, although the full data set on investment flows and capital stocks, as well as the yearly values for the interest rates used for the original study, were not available. The 2009 study provides data on capital stocks for the initial (1970) and final (2006) years covered. Based on the initial ratios of value added (VA) for the public and private sectors and rates of return to each sector, we estimated the ratios of reproducible[5] private sector capital stocks, public sector capital stocks, and capital to GDP (K/Y), which are similar to the ratios estimated in the Penn World Table, version 8 (July 2013)[6] and other studies (Hofman, 2000; Loría and de Jesús, 2007).

[5] Reproducible here means subject to increase by investment less depreciation.

[6] According to the website description, the Penn World Table "provides purchasing power parity and national income accounts converted to international prices for 189 countries/territories for some or all of the years 1950–2010." For more information, see https://pwt.sas.upenn.edu/php_site/pwt_index.php.

These estimations allowed us to recreate the estimated rates of return to private capital using the simplified weighted cost of capital methodology chosen by Rodriguez (2009). To arrive at the estimated EOCK rate for the entire 1970–2006 period and extend it to 2012 using more recent national accounts data, these results have to be combined with the marginal cost of foreign savings or borrowing (MCFS). For this initial assessment, the MCFS is taken from the Rodriguez (2009) study as a constant variable. Because the elasticity of response is assumed to be zero in the original document, there is no data for rates of return on domestic savings.

Figure 1 EOCK trends for Mexico: An update of the 2009 Rodriguez calculations to 2012



Source: Authors' calculations using the methodology by Rodriguez (2009), updated to 2012.

The EOCK estimations for Mexico show a downward trend, mostly driven by the evolution of the rates of return in the private sector. Confirming the results of the Rodriguez (2009) study, the recalculation shows a downward trend for Mexico's EOCK (the upper trend line in

blue shown in Figure 1), which is driven by the downward trending estimated rates of return in the private sector, with a constant marginal impact by the MCFS. This responds to the relatively high elasticity of domestic investment to the interest rate (assumed in the 2009 study as −1.8), which is unusually high, and a lower elasticity for the supply of foreign savings (1.0) as well as the initial share of foreign savings in total savings for Mexico. As mentioned above, the Rodriguez (2009) study assumes zero elasticity for domestic savings.

After replicating the methodology proposed by Rodriguez (2009), we took into account the estimated contribution of domestic savings, considering sensitivity to alternative elasticities of supply based on empirical evidence from different sources. Jenkins, Kuo, and Harberger (2010) use a supply elasticity of newly stimulated domestic savings of 0.4 and a supply elasticity of foreign savings of 3.0 for the re-estimation of the EOCK for Canada. Jenkins and El-Hifnawi (1993) use a savings elasticity of 0.50 for the estimation of the EOCK for Indonesia. Annex V highlights additional studies. The rates of return on savings were adopted as a constant variable at 5.4 percent in real terms, which Rodriguez (2009) uses as the starting interest rate to estimate the MCFS.

The second trend line in Figure 1 (in red) reflects the impact of domestic savings with an elasticity of supply (Eds) of 0.40. As we can observe from the results, when extending the estimation from 2006 to 2012, we arrive at a final EOCK of about 11 percent without contribution from domestic savings, while taking into consideration the impact of domestic savings we reach an estimated value of 10 percent. To reduce the impact of yearly fluctuations in the data, it would be preferable to use an average for the 2003–2011 period, which comes to 11.8 percent for the series without domestic savings and 10.5 percent when taking displaced domestic consumption—and thus domestic savings—into consideration. We use these initial results, which confirm the EOCK results obtained in the Rodriguez (2009) study, as a starting point for a more detailed analysis in the next section, including reasonable assumptions about the impact of domestic savings.

3.1.3 Methodology applied to Mexican data: Sources of data and related issues

In this section we employ the traditional weighted cost of capital approach, but with some differences in the calculation of net income to capital and in the considerations on the applicable capital stocks. The starting point is the national accounts data from a top-down perspective. From GDP, we deduct indirect taxes and depreciation to arrive at net domestic product at basic (or factor) prices. This, in turn, is divided between income to labor and income to capital (net operating surplus).

The initial data is adjusted for the estimates of labor income contained in the capital income accounts. According to several authors such as Caselli and Feyrer (2007), Karabarbounis and Neiman (2012), and Guerriero (2012), the labor share in national domestic product has to be adjusted for the labor share of mixed income (self-employed, non-paid family labor, unincorporated businesses) reported as capital income. This adjustment increases the labor income share and thus reduces the income accruing to capital. In addition, we deduct from the income accruing to capital the portion that can be considered income accruing to land. We then further adjust the income to capital by adding the proportion of indirect taxes that can be attributed to capital income. For the estimation of labor shares, we apply the methodology proposed by Guerriero (2012).

Box 2: On labor income in developing countries

"Especially in developing countries, the self-employed and the people working in family enterprises account for a very big portion of the workforce. Self-employment represents not only emerging entrepreneurship and business start-up, but also marginal employment and disguised unemployment (Gollin, 2002). As a result, in developing countries labour income is badly understated by the employees' compensation measure, which also risks changing significantly only as a consequence of a possible trend away from informal employment." (Guerriero 2012, 5).

The data reported in the national accounts requires an adjustment to ensure proper representation of the share of net national income accruing to labor. In the computation of the labor share, which is a ratio to national income, the labor income component needs to be

derived and added to the compensation of employees as reported in the national income accounts. For the computation of its denominator—the income aggregate—a few adjustments are required. First, taxes on production and imports (minus subsidies) are removed from the gross value added at basic prices. The calculations are based on information from the UN System of National Accounts using the main methodologies proposed in the literature on the labor share of income (Bernanke & Gürkaynak, 2001; Diwan, 2001; Harrison, 2002; Jayadev, 2007).

We adjust the labor share following the methodology proposed by Guerriero (2012). Based on the six alternative adjustments to the labor share proposed in the Guerriero (2012) study—which are summarized in Annex IV—this study focuses in particular on the definitions coded by the author as LS4 and LS5:

- LS4 = [compensation of employees]/[value added (– indirect taxes – depreciation of fixed capital) – mixed income]. This ratio assumes that the share of labor income is the same in the corporate and non-corporate sectors. Typically, the non-corporate sector is expected to be more labor-intensive than the corporate sector, so that this adjustment will tend to understate the labor share adjustment. Note that in Appendix E of the Guerriero study, the labor share for Mexico under LS4 is 0.48, while under definition LS5 it is 0.60 (Guerriero 2012, 32–6).

- LS5 = [compensation of employees * total workforce/number of employees]/[value added (– indirect taxes – depreciation of fixed capital)]. This ratio assumes that the wage rates in the unincorporated sector are the same as in the corporate sector, when typically they are expected to be lower in the unincorporated sector. Therefore, this ratio will tend to marginally overstate the labor share adjustment.

The actual adjustment is expected to be between LS4 and LS5. Hence, we use an average of the two methods to adjust for the labor share in the unincorporated sector and the self-employed sector for the estimations of labor income in Mexico. Relying on various national statistics

sources for Mexico (ILO, UN, SHCP) on labor markets and mixed income, an average estimation of ratios[7] LS4 and LS5 of the labor share of value added was selected from the different proposed and possible ratios. The fact that they reflect a middle range of values allows us to re-estimate the income accruing to capital (on the basis of this methodology and data).

The standard definition of capital income implies measuring it net of capital consumption. Therefore, where data are available, consumption of fixed capital has been subtracted from the measure of value added, obtaining a net income measure.

After the adjustments described above, the income accruing to capital is divided by the stock of private capital, including the value of inventory stocks and land. The values for capital stocks are calculated using the perpetual inventory method (results that are calculated by dividing investment flows by the sum of depreciation and growth of capital stocks in percentage terms). The resulting series is then compared to GDP and the ratios (K/Y) compared to other Mexico-specific and broader international studies to assess its acceptability. This provides the first set of empirical results under different assumptions for labor's share and income accruing to capital and the corresponding returns to private capital in Mexico.

Because PEMEX affects the estimation of the rates of return in the Mexican economy, the EOCK calculation is likewise affected. Further analysis on the rates of return to capital in Mexico should also consider the impact that large companies can have on the results. If we separate the income accruing to PEMEX and to the rest of the private sector, then divide these incomes by the respective stocks of capital plus inventories, we obtain separate rates of return for each subsector. This process allows us to assess the contribution of PEMEX—a large state-owned enterprise that has very high returns and is also heavily taxed by the state—to the rates of return in the economy. These results can have an impact on the calculations of the EOCK when using the traditional method (top-down approach using national accounts data under different scenarios). In addition, the analysis in separate accounts is useful for the discussion of the bottom-up approach to the EOCK calculation for public sector projects in Mexico.

[7] See Annex IV for a full discussion of each definition of the labor shares estimation.

3.2 Estimation of the gross rates of return for invested private sector capital, 2003–2011

Based on the discussion in section 3.1, this section will focus on the estimation of the EOCK and the necessary intermediate calculations for the 2003–2011 period, using SHCP data for those years. The base year for the nominal and real values used in the calculations is 2003.

3.2.1 Rates of return to private sector capital

The national accounts data allow us to differentiate our assessment of income accruing to capital versus income accruing to labor. We obtain GDP at factor costs from the national accounts data by taking GDP at market prices and deducting taxes on output. We then obtain the amounts accruing to labor, capital, and indirect taxes. The data shows that the income accruing to capital in the national accounts is more than double the income accruing to labor (see Table 1). Depreciation is reported as part of the gross operating surplus.

Table 1 National accounts: Shares of income to factors of production, 2003–2011 (million pesos)

Year	GDP (nominal)	*Less*: Indirect taxes on output	Gross value added (GVA) at factor costs	Labor income	Indirect taxes paid out of GVA	Capital income	Depreciation	Gross operating surplus (= GVA less labor income)
2003	7,555,803	393,030	7,162,773	2,370,474	304,878	4,487,421	683,354	4,792,299
2004	8,574,823	390,210	8,171,095	2,540,339	399,461	5,231,295	759,183	5,630,756
2005	9,251,737	395,564	8,825,085	2,729,235	519,324	5,576,526	804,314	6,095,849
2006	10,379,091	400,971	9,943,093	2,955,305	579,641	6,408,148	883,697	6,987,788
2007	11,320,836	436,368	10,854,384	3,172,663	614,088	7,067,633	972,737	7,681,721
2008	12,181,256	315,664	11,837,772	3,409,255	971,440	7,457,077	1,095,587	8,428,517
2009	11,937,250	499,027	11,394,220	3,474,162	580,608	7,339,451	1,264,601	7,920,058
2010	13,071,597	543,592	12,485,511	3,678,700	722,627	8,084,184	1,306,076	8,806,811
2011	14,395,833	507,736	13,843,758	3,955,335	932,639	8,955,784	1,382,400	9,888,423

Source: National accounts for Mexico, SHCP (2013) and INEGI.

From the national accounts data we see that the share of labor out of GDP at factor costs is 30 percent, while out of net domestic product at factor costs it is 33 percent on average for the

period. Correspondingly, the income accruing to capital, as per the national accounts, comes out to 67 percent of net domestic product as an average for the period. In this case, labor income only includes labor employed by corporate entities, not the self-employed or those working for unincorporated employers (see Table 2.1).

Table 2.1 Mexico: Labor income shares, 2003–2011

Year	Gross value added at basic prices [million pesos]	Labor income over GDP at factor costs	Net domestic product at factor costs (GVA – depreciation) [million pesos]	Labor income over net domestic product at factor costs	Mixed income [million pesos]	Net domestic product at factor costs less mixed income [million pesos]	Labor income over [NDP at factor prices less mixed income]
2003	7,162,773	33%	6,479,420	37%	1,359,937	5,119,483	46%
2004	8,171,095	31%	7,411,912	34%	1,497,569	5,914,343	43%
2005	8,825,085	31%	8,020,770	34%	1,875,614	6,145,156	44%
2006	9,943,093	30%	9,059,396	33%	2,049,152	7,010,244	42%
2007	10,854,384	29%	9,881,647	32%	2,260,332	7,621,315	42%
2008	11,837,772	29%	10,742,185	32%	2,505,541	8,236,644	41%
2009	11,394,220	30%	10,129,619	34%	2,384,723	7,744,896	45%
2010	12,485,511	29%	11,179,435	33%	2,674,661	8,504,774	43%
2011	13,843,758	29%	12,461,358	32%	2,945,621	9,515,737	42%

Source: SHCP; for mixed income: UN and SHCP.

Once we exclude mixed income earned in self-employed and unincorporated activities, the labor income out of net value added at factor prices increases by about 10 percent. If the labor income contained in mixed income is assumed to be the same share as in the corporate sector, then the labor income in the corporate sector can be adjusted to include this same share of mixed income. This is shown in Table 2.2 for method LS4, such that the adjusted labor share averaged 43 percent of the net domestic product (NDP) at factor costs over the period. This is expected to underestimate the labor share of the unincorporated sector, so the alternative estimate under method LS5 assumes that the wage rates in the unincorporated sector are the same as in the corporate sector. Table 2.2 shows that this raises the adjusted labor income share to an average of 51 percent over the period. Given that wages in the unincorporated sector are expected to be lower on average than in the corporate sector, using the average of these two

estimates results in an average labor share of 47 percent (last column in Table 2.2). This adjusted labor income is used in the subsequent estimates.

Table 2.2 Labor income adjusted for labor income share of mixed income, 2003–2011

Year	Labor income adjusted for mixed income (LS4 method)	Adjusted labor income (LS4) over NDP at factor costs	Labor income adjusted for mixed income (LS5 method)	Adjusted labor income (LS5) over NDP at factor costs	Average labor income adjusted for mixed income	Average adjusted labor income over NDP at factor costs
2003	3,000,166	46.3%	3,751,545	57.9%	3,375,856	52.1%
2004	3,183,578	43.0%	4,014,771	54.2%	3,599,175	48.6%
2005	3,562,248	44.4%	4,244,344	52.9%	3,903,296	48.7%
2006	3,819,165	42.2%	4,519,693	49.9%	4,169,429	46.0%
2007	4,113,612	41.6%	4,843,730	49.0%	4,478,671	45.3%
2008	4,446,331	41.4%	5,173,867	48.2%	4,810,099	44.8%
2009	4,543,887	44.9%	5,274,945	52.1%	4,909,416	48.5%
2010	4,835,612	43.3%	5,299,665	47.4%	5,067,639	45.3%
2011	5,179,720	41.6%	5,992,660	48.1%	5,586,190	44.8%

Source: SHCP; for mixed income: UN and SHCP.

3.2.2 Capital stocks

The perpetual inventory method is used to estimate the stocks of capital for the public and private sectors. We also use disaggregated series of investments into private and public stocks of capital divided into construction and equipment. Using standard procedures, we adopted medium levels of depreciation, 2.5 percent per year for construction and 6 percent for equipment. As is the case in many studies, the sensitivity of the ratios of stocks of capital to GDP or the reported rates of return to private capital to different plausible depreciation rates did not have a significant impact, since the depreciation rates enter both the numerator and the denominator of the ratios. The total capital to GDP (or K/Y), which averaged 2.9 over the 2003–2011 period, is in line with many other studies in Mexico (Cervini, 2004). The ratio of private capital over GDP (Kpri/Y) averaged 2.23 over the same period.

3.2.3 Land and inventory stocks

The estimates of capital income and returns are further adjusted for the value of land in capital stocks. The value of land calculations are drawn from studies that estimate the composition of assets in a range of countries, including Mexico (see Caselli and Feyrer, 2007; World Bank, 2006). Based on these studies, an estimate of 18 percent is used here as the share of the value of land out of the value of reproducible capital plus land. The 18 percent represents the share of urban land over the total capital stocks. This is low compared to the estimate for the U.S. land share of total capital value, which comes to 20–26 percent over the 1960–2003 period (OMB, 2005). According to Caselli and Feyrer (2007), for world average parameters, the estimates of the share of reproducible capital on the total stock is about 75 percent—in other words, the proportion of land and land-related resources to reproducible capital stocks is close to 25 percent. In this study we adopt a conservative estimate.

The land share value in capital stocks gives us a ratio of private capital to GDP, including land, of 2.72 for the 2003–2011 period, from a value of 2.23 without land. Adding the ratio of stock of inventories to GDP, which was estimated with long-term national accounts series at an average of 1.47 over the 2003–2011 period, the private stock of capital, land, and inventories in relation to GDP (the ratio) comes to 4.19 for that same period. The stocks of inventories were constructed using long-term series data for changes in inventory for Mexico. The rates of investment on inventories reported for Mexico are comparatively high in the international context, averaging 4.2 percent of GDP over the 2003–2011 period. Further research is advisable to confirm and understand why Mexico has such a relatively high level of investment in increased inventories. As can be observed in the last column of Table 3, the ratio of capital, plus land and inventories, is quite stable for the period from 2003 to 2011.

Table 3 Ratios of reproducible capital, land, and inventories to GDP at market prices, 2003–2011

Year	Total capital over GDP	Private capital over GDP	Private capital + land over GDP	Inventories over GDP	Private capital + land + inventories over GDP
2003	2.75	2.14	2.61	1.59	4.20
2004	2.75	2.13	2.60	1.56	4.16
2005	2.77	2.15	2.62	1.53	4.15
2006	2.76	2.14	2.61	1.47	4.07
2007	2.79	2.16	2.64	1.42	4.06
2008	2.89	2.22	2.71	1.41	4.12
2009	3.18	2.43	2.97	1.49	4.46
2010	3.11	2.37	2.89	1.41	4.30
2011	3.10	2.34	2.86	1.34	4.20

Source: SHCP; World Bank; UN.

To calculate the rate of return on private capital stock, the first step is to adjust the net income earned by capital in the economy for the labor income adjusted for the share of self-employed labor income in mixed income. Net income earned by private capital is the NDP at factor costs (GVA – depreciation) less the average adjusted labor income. Over the 2003–2011 period, this averaged 45.8 percent of GDP (see Table 4), or 52.9 percent of NDP.[8] Second, given the estimated total private capital (reproducible capital, land, and inventories), the rate of return on private capital averaged 10.9 percent over the period. Third, this rate of return includes all corporate income taxes, property taxes, and other indirect taxes paid out of value added, but it excludes any net indirect taxes collected in the product markets on the output of capital. When the share of net indirect taxes in the product markets is allocated to the value added earned by capital, the gross of indirect tax return to capital rises by an average of 0.6 percent, to a gross return to capital (π in the weighted average EOCK discussed above) of an average of 11.6 percent over the 2003–2011 period.[9]

[8] NDP is about 86.5 percent of GDP for the 2003–2011 period.

[9] The estimate of the gross return to private capital could be further refined by: (i) adding in the imputed rent on private owner–occupied housing and (ii) adjusting the income and capital stocks for the investments in intangible assets. These two adjustments would increase the return on capital, but would be offset by including the full value of private working capital, namely, the cash balances held for transaction purposes and net receivables.

Table 4 Net capital income and gross rate of return to private capital (reproducible capital, land, and inventories), 2003–2011

Year	Average labor share adjusted for mixed income [million pesos]	Net capital income (NDP − adjusted labor income) [million pesos]	Net capital income over GDP	Private capital + land + inventories over GDP	Return to private capital	Indirect taxes over private capital + land + inventories	Gross return to private capital (π)
2003	3,375,856	3,103,564	41.1%	4.20	9.8%	0.7%	10.5%
2004	3,599,175	3,812,738	44.5%	4.16	10.7%	0.6%	11.3%
2005	3,903,296	4,117,474	44.5%	4.15	10.7%	0.6%	11.3%
2006	4,169,429	4,889,967	47.1%	4.07	11.6%	0.6%	12.2%
2007	4,478,671	5,402,976	47.7%	4.06	11.8%	0.6%	12.4%
2008	4,810,099	5,932,086	48.7%	4.12	11.8%	0.7%	12.5%
2009	4,909,416	5,220,203	43.7%	4.46	9.8%	0.6%	10.4%
2010	5,067,639	6,111,796	46.8%	4.30	10.9%	0.7%	11.5%
2011	5,586,190	6,875,168	47.8%	4.20	11.4%	0.7%	12.1%
Average					**10.9%**		**11.6%**

Source: SHCP; for mixed income: UN and SHCP.

3.2.4 Estimation of the net rates of return on domestic and foreign savings: Analysis of returns in stock and security markets, pension funds, and banking sector reports

To assess the rates of return on savings, we look at real rates of return on government securities, private sector instruments, and pension funds (see Table 5). There are an increasing number of instruments and institutions in the capital markets in Mexico. To construct a representative series of returns for domestic savers, we estimate the real returns obtained by pension funds in Mexico, as well as the equity returns from the stock market index (MXXD) reported by the stock exchange. We also look at returns on interest rates on long-term government bonds and debt in real terms per year. We use yearly average values for equity returns. We then assess the information from the stock exchange using the Erb, Harvey, and Viskanta (1995, 1996) methodology (see Annex VIII). Using different reports from Banamex and SHCP, we used equity to debt ratios of 40/60 to weigh[10] the returns, reflecting the market

[10] The share allocated to debt is taken to include savers' investments in housing.

conditions on average.[11] For consistency, we use the gross returns to capital information (Table 4) in the last column of Table 5 to report the gross returns to saving, by deducting from gross of tax returns, taxes per unit of capital, as well as the value added of financial services divided by the capital stocks plus inventories and land. We can observe that, although there is some small difference in the trends, the weighted average real returns to different instruments and the top-down net returns (gross returns less taxes and capital intermediation) give very similar averages. The top-down calculation is used for the rates of return on savings and the average estimated return on different instruments as the basis to estimate the marginal cost of foreign savings.

Table 5 Rates of return to pension funds, private sector, and public sector bonds, 2003–2011

Year	Siefores pension funds (real rates of return)	Traded equity (real rates of return)	IFS government securities (real interest rates)	Banxico corporate bonds (real interest rates)	World Bank external debt (real interest rates)	Weighted average* (real rates of return)	Top-down gross returns to capital less taxes and financial intermediation
2003	13.5%	15.8%	5.0%	3.4%	5.9%	9.2%	7.9%
2004	11.6%	14.3%	5.1%	4.9%	6.1%	8.9%	8.5%
2005	10.8%	13.5%	6.4%	8.0%	6.5%	9.6%	8.1%
2006	11.4%	13.0%	4.6%	6.9%	7.0%	8.9%	8.7%
2007	10.4%	11.7%	4.2%	6.1%	6.9%	8.1%	8.9%
2008	7.6%	11.2%	2.3%	4.0%	5.3%	6.8%	8.3%
2009	6.6%	12.6%	5.1%	3.4%	4.8%	7.7%	7.2%
2010	8.8%	12.3%	3.5%	4.6%	4.4%	7.4%	7.9%
2011	8.7%	12.2%	4.3%	4.6%	4.7%	7.6%	9.4%
Average	**9.9%**	**13.0%**	**4.5%**	**5.1%**	**5.7%**	**8.2%**	**8.3%**

Source: INEGI; Banco de México; IFS (IMF); Global Finance Statistics; World Bank External Debt Data.
* Weighted average return based on 40 percent equity and 60 percent debt at average government, corporate, and external interest rate.

[11] Note that a large share of private savings is in residential housing that yields a real financial rate of return similar to debt interest rates.

3.3 Results of the EOCK estimation for Mexico for the 2003–2011 period

This section shows estimations obtained for Mexico's EOCK. The shares of investment for the private sector, as well as domestic and foreign savings data, have been incorporated in percentage terms from the national accounts. Based on several reference studies (see Annex V), we also adopt mid-range values for the elasticities of demand for investments ($\eta = -1.0$), for supply of domestic savings (Eds = 0.30), and for supply of foreign savings[12] (Efs = 3.0). In the calculation we include the gross of tax returns to private capital and the rates of return to domestic savings (rs) and foreign savings (rf) (see Table 6.1). Annex V (see V.4) explains why, despite foreign savings forming a relatively small share of total savings, they have a high supply elasticity, and hence, form a relatively larger share of capital funds supporting marginal investments. The shares of investments and domestic and foreign savings over GDP in percentage terms have been calculated from the national accounts.

Table 6.1 Investment, savings, elasticities, and weights for the EOCK estimation, 2003–2011

Weights for the computation of the EOCK				Elasticities			Weights (f1–f3)		
	Private GFKF + inventory investment/ GDP	Domestic savings/ GDP	Foreign savings/ GDP	**η**	**Eds**	**Efs**	Inv. Investment	DS Domestic savings	FS Foreign savings
				Investment	Dom. sav.	For. sav.	**f1**	**f2**	**f3**
2003	19.1%	22.9%	1.1%	−1	0.3	3	64.9%	23.4%	11.7%
2004	20.5%	24.9%	0.9%	−1	0.3	3	66.9%	24.3%	8.7%
2005	19.8%	24.4%	1.0%	−1	0.3	3	65.6%	24.2%	10.2%
2006	21.8%	26.2%	0.8%	−1	0.3	3	68.2%	24.5%	7.2%
2007	21.9%	26.5%	1.4%	−1	0.3	3	64.4%	23.4%	12.2%
2008	21.3%	26.9%	1.8%	−1	0.3	3	61.4%	23.3%	15.3%
2009	17.7%	23.8%	0.8%	−1	0.3	3	64.6%	26.1%	9.3%
2010	18.0%	23.9%	0.2%	−1	0.3	3	69.5%	27.6%	2.8%
2011	19.8%	25.1%	0.9%	−1	0.3	3	66.3%	25.1%	8.6%
Average	**20.0%**	**24.9%**	**1.0%**				**65.8%**	**24.7%**	**9.6%**

Source: Authors' calculations using SHCP data.

[12] Foreign savings are defined as the amount of net inflows of foreign capital funds (debt, portfolio investments, direct investment, etc.) into Mexico reduced by the amount of net outflow of investment by Mexicans outside of Mexico and by the net additions to foreign reserves.

In addition, for the calculation of the EOCK below, we report the estimated rates on investment, the net of tax real rates on domestic savings, as well as the marginal opportunity cost of foreign savings. For domestic savings, the economic opportunity cost of savings (rs) is taken as the return to saving reduced by the taxes on the income earned on saving at an effective tax rate of 10 percent. For the marginal opportunity cost of foreign savings in Table 6.2, we use the formula: MCFS = rf * (1−ts) * (1+k/Efs), where rf is the weighted average interest rate on savings in real terms (from Table 5); ts is the tax rate on savings; k is the share of foreign capital that is responsive to changes in interest rates; and Efs is the elasticity of supply of foreign savings. We adopt the following values for our estimation: ts = 10 percent; k = 0.90; and Efs = 3.0.

Table 6.2 Rates of return on investments and domestic and foreign savings, 2003–2011

EOCK input values	Domestic investment rates of return *π*	Domestic savings rate (net) *rs*	Foreign savings marginal cost *MCFS*
2003	10.5%	7.1%	10.7%
2004	11.3%	7.7%	10.5%
2005	11.3%	7.3%	11.2%
2006	12.2%	7.9%	10.4%
2007	12.4%	8.0%	9.5%
2008	12.5%	7.5%	8.0%
2009	10.4%	6.5%	9.0%
2010	11.5%	7.1%	8.7%
2011	12.1%	8.4%	8.9%
Average	**11.6%**	**7.5%**	**9.7%**

Source: Authors' calculations using SHCP, INEGI, BAMEX, IFS (IMF), Global Finance Statistics (IMF), and WDI data.
Note: For domestic and foreign savings, effective tax rates of 10 percent have been assumed.

Box 3: Data sources

The estimation of the EOCK is based on the following data sources:

- The national accounts data: SHCP, the Unidad de Análisis de Proyectos de Inversión, INEGI, Banco de México, OECD, IMF, World Bank;
- Labor employment, compensation, mixed income: SHCP, UN Statistics, ILO, INEGI;
- Capital market information: SHCP, Banco de México, UN, IMF;
- Taxes and different sectors: OECD, SHCP.

For future reference, in addition to consistent sets of data on the national accounts, a selected set of statistics on labor, wages, mixed income, as well as the different forms of taxation and the corresponding sector of origin will be critical to further strengthen the proposed approach.

3.3.1 Results of the estimation

The estimation of the EOCK for Mexico, which comes out to 10.4 percent (Table 7), is obtained by applying the weights to the relevant returns. By applying the average weights to domestic investment (f1), domestic savings (f2), and foreign savings (f3) that result from the calculation presented in the table, as well as the rates of return reported earlier for gross of tax returns to domestic investment (π), net of tax returns to domestic savings (rs), and marginal cost of foreign savings (MCFS), we can estimate the EOCK for the 2003–2011 period.

Table 7 Top-down approach for the EOCK, 2003–2011

	Domestic investment	Domestic savings	Foreign savings
	f1	*f2*	*f3*
Average weights	65.8%	24.7%	9.6%
	π	*rs*	*MCFS*
Rates of return	11.6%	7.5%	9.7%
EOCK			**10.4%**

3.3.2 Discussion and sensitivity analysis of the results

The sensitivity analysis confirms that taking into account the domestic savings elasticity is critical. As capital markets develop in Mexico, different financial savings instruments are becoming available to savers (households, corporations, pension funds). This will necessarily result in higher elasticities of savings (or the response from these sectors). Assuming a higher elasticity of savings response, from 0.30 to 0.60, would tend to lower the EOCK by 0.6 percent, as the last row and middle columns of Table 8.1 and Table 8.2 show. The possible changes with plausible ranges for the elasticity of domestic investment do not have a significant effect on the EOCK.

Table 8.1 Sensitivity analysis of the EOCK for investment and domestic savings elasticities

		Investment elasticity		
		−0.8	−1	−1.2
Domestic savings elasticity	0.10	10.8%	11.0%	11.0%
	0.30	10.2%	**10.4%**	10.5%
	0.60	9.6%	9.8%	10.0%

Table 8.2 Sensitivity analysis of the EOCK for foreign savings and domestic savings elasticities

		Foreign savings supply elasticity		
		1	3	5
Domestic savings elasticity	0.10	11.2%	11.0%	10.7%
	0.30	10.6%	**10.4%**	10.2%
	0.60	9.9%	9.8%	9.7%

An estimation of the impacts of foreign savings elasticities shows that these are not as critical as the domestic response elasticity. In part, this is embedded in the formula for the marginal economic cost of foreign saving (MCFS), as the elasticity in the second term is also in the denominator. The other important reason in the context of Mexico is the relatively small share of net foreign savings in the economy in recent years.

4 Supply price approach to the EOCK for government, state-owned enterprises, and regulated investment projects

4.1 Using the supply price approach to estimate the EOCK

This section estimates the EOCK by adopting an approach that considers the minimum supply price of capital plus the economic externalities of the use of capital. As discussed in section 2.3 above, this "bottom-up" methodology considers the tax externalities per unit of capital and uses the same weights as the traditional "top-down" weights from the national accounts methodology for domestic investments, domestic savings, and foreign savings. In order to obtain the EOCK for the economy, the result of the overall tax externality per unit of capital invested must be combined with the minimum supply price of capital in the market (i_m, in percentage terms per year), which comes from debt and equity sources. This part of the discussion assumes that we are dealing with the opportunity cost of capital supplied to an investment project that represents the financing of the foregone investment and the same capital funds supplied in the top-down case. This discount rate thus serves as the economic reference price for public sector projects in the absence of variations in the cost of capital for different projects. We will show that, in principle, following the top-down or bottom-up methodology for the average investment should yield similar or comparable results.

First, the tax collection per unit of capital was estimated based on data available for general government tax revenues by major category. The financial sum of taxes collected from the operations of the private sector (income taxes, property taxes, indirect taxes paid out of capital income, plus the share of indirect taxes in the product markets attributable to the contribution of capital to value added) was divided by the sum of capital stocks of the private sector, including the value of land and inventories, to obtain an average rate of taxation to capital in Mexico for the 2003–2011 period. The result was 2.3 percent of capital stocks, including land and inventories (Table 9).

Table 9 Taxes on capital over GDP, 2003–2011 averages

Type of tax	Taxes as share of capital
Taxes on capital income and assets of corporate and capital share of non-corporate businesses	
as a share of private reproducible capital + land	0.7%
as a share of private reproducible capital + land + inventories	0.5%
Taxes on property values	
as a share of private reproducible capital + land	0.1%
as a share of private reproducible capital + land + inventories	0.1%
Indirect taxes paid out of capital income (taxes on mining and oil)	
as a share of private reproducible capital + land	1.7%
as a share of private reproducible capital + land + inventories	1.2%
Share of indirect taxes in product markets (VAT, customs and excise) attributable to capital	
as a share of private reproducible capital + land	1.0%
as a share of private reproducible capital + land + inventories	0.6%
Total tax distortion on capital assets	
as a share of private reproducible capital + land	3.4%
as a share of private reproducible capital + land + inventories	2.3%

Source: SHCP; OECD tax data.

Second, the weighted average externality for invested capital was estimated. We combine the tax externality on capital of 2.3 percent (from Table 9) with the tax gain from domestic savings and the net externality from foreign savings. The tax gain is the result of the multiplication of the savings rate of 8.3 percent times the assumed average tax on savings of 10 percent for a negative tax externality (or a tax gain) of −0.8 percent. The tax externality on foreign savings has a tax gain of 8.2 percent times a 10 percent assumed withholding tax rate (***tw***) or −0.82 percent and a positive tax externality of $\boldsymbol{i_m}$*(1 − ***tw***)*k/Efs. With k = 0.90 (share of foreign savings responsive to changes in the market interest rate), tw = 10 percent (withholding tax), and Efs = 3.0 (elasticity of supply of foreign savings), this results in a positive tax externality of 2.22 percent. Considering both the positive and the negative tax externalities yields a total of 1.4 percent (2.22 – 0.82 percent). Based on these estimations, the different tax distortions—such as the tax distortion per unit of capital invested, the tax distortions on savings (e.g. the interest rate times the tax on savings income, with a negative value or negative

externality), and the tax distortion on foreign savings—have to be compounded using the same weights as the traditional EOCK. Using the same weights as in the previous exercise (f1 to f3 from Table 7), the weighted externality per unit of capital used in Mexico would be a relatively low 1.4 percent per unit of capital (Table 10).

Table 10 Externality per unit of capital

	Domestic investment	Domestic savings	Foreign savings
	f1	*f2*	*f3*
Average weights	**65.8%**	**24.7%**	**9.6%**
Return		8.3%	8.2%
Tax rate		10%	10%
Distortions/unit of capital	2.3%	−0.8%	1.4%
EOCK externalities/unit of capital			**1.4%**

The results for the EOCK are robust when compared to those obtained through the alternative approaches considered. If we add a weighted cost of private funds (i_m) of 8.9 percent (Table 11) and the EOCK externality per unit of capital of 1.4 percent (Table 10), we obtain an EOCK for Mexico of 10.3 percent, similar in magnitude to the value of 10.4 percent that was estimated using the top-down approach from national accounts data. Some differences can be explained by the average values for both the prices of debt and equity, as well as the ratios in the weights, which are an approximation.

4.2 Consistency of the results and interpretation

As we can observe, the results for the top-down and bottom-up approaches are very consistent—both methodologies point to a new recommended EOCK for Mexico of about 10 percent. In this study we used the approximations from market information about Mexico (corporate bonds 30 percent, stock exchange 40 percent, and housing investments 30 percent of market shares representing the private sector in Mexico) and the rates of return from Table 5 and Annex IX. We obtain 10.4 percent EOCK from the top-down approach and 10.3 percent from the bottom-up approach. These results, in addition to those obtained from reviewing the existing

methodology updated to 2012 (with an EOCK of about 10 percent), give us an indication of the recommended EOCK value for Mexico: a rounded 10 percent discount rate.

Table 11 Comparing the two approaches to estimate the EOCK, 2003–2011

Bottom-up and top-down estimations					
Gross return excluding share of indirect taxes (Table 4)					10.9%
Taxes paid out of return on capital (Table 9, less indirect taxes)					1.7%
Net of tax return, private sector					**9.2%** [top-down]
Market representation:		Real rates of return	Weights in private investment		
Corporate bonds (Table 5)		5.1%	30%	1.5%	
Real return on equity (Table 5)		13.0%	40%	5.2%	
Housing return (from Annex IX)		8.3%	30%	2.5%	**9.2%** [same]
	Investment f1	Domestic savings f2	Foreign savings f3		
Average weights	65.8%	24.7%	9.6%		
Net of tax return on investment or gross of tax return on savings	**9.2%**	8.3%	8.2%		
Weighted supply cost of capital (private sector)			**8.9%**	**WACC [A]**	
Adding back the tax externality:					
Weighted average cost of capital (WACC for private sector)			**8.9%**	[A]	
EOCK externality/unit of capital			**1.4%**	[B, from Table 10]	
EOCK, bottom-up approach			**10.3%**	[A+B]	
Top-down	Investment f1	Domestic. savings f2	Foreign savings f3		
Average weights	65.8%	24.7%	9.6%		
Rates	11.6%	7.5%	9.7%		
EOCK, top-down approach			**10.4%**	[same magnitude]	

4.3 Estimating the tax externality in the case of disaggregation of PEMEX from the rest of the economy

In the final step of our analysis we assess the impact of PEMEX on EOCK externalities. The impact of the tax externalities per unit of investment in PEMEX and the rest of the economy is investigated. From the tax revenue for general government information and from national account information, we obtain a PEMEX capital distortion of 50.8 percent per unit of capital plus inventories invested, in addition to a staggering share of all taxes of 30.6 percent (see Table 13).

4.3.1 The private return to capital in PEMEX and the rest of the private sector

In the next stage of the analysis we distinguish between two scenarios: one in which we disaggregate PEMEX and another in which we do not. In Table 12, the income to private capital and stocks of capital are now disaggregated into PEMEX and non-PEMEX accounts, based on available PEMEX data. The net capital income (or net operating surplus) in the private sector is split between PEMEX (based on its accounts) and the residual to non-PEMEX entities in the private sector. Over the 2003–2011 period, PEMEX captured 10.6 percent of the net capital income. In terms of assets, based on the book assets and investment of PEMEX, a perpetual inventory method asset series was created, in order to make it comparable with the private sector asset series. This asset series raises the value of PEMEX assets by 17.5 percent on average over the timeframe covered. While PEMEX assets only averaged 3.2 percent of the total private sector capital assets during the 2003–2011 period, PEMEX investment in fixed capital assets averaged 10.9 percent of total private investment. PEMEX net capital income and assets generated a high rate of return of 36.8 percent on average, but, interestingly, the rate of return dropped from 42.6 percent in the 2003–2008 period to 25.2 percent in the 2009–2011 period, while investment levels by PEMEX rose from 7.8 percent of GDP to 11.1 percent over the same two periods. Finally, the share of the indirect taxes in the product markets attributed to capital income (about 0.1 percent) was added in order to assess the average gross rate of return to capital, which came out to 36.9 percent. Table 12 also shows the non-PEMEX entities earning the remaining 89.4 percent of net capital income on the residual 96.8 percent of capital stocks in

the private sector. This results in a change of the gross rate of return to the residual private capital from an average of 11.6 percent (see Table 4) to an average of 10.7 percent (Table 12). After adjusting for the income that accrues to land and the stocks of long-term inventories, the returns to private capital net of indirect taxes are now on average 10.1 percent for the 2003–2011 period; and gross of indirect taxes attributable to capital, they go up to 10.7 percent for the same period.

Table 12 Estimation of the rates of return to capital in PEMEX and the remainder of the private sector, 2003–2011

	Net income to capital (or net operating surplus) [million pesos]	Share of net capital income to private sector	Net capital income over GDP	Share of capital assets	Private capital + land + inventories over GDP	Return on total capital	Share of indirect taxes in product markets	Gross return on total capital
PEMEX								
2003	367,567	11.8%	4.9%	2.7%	0.11	43.5%	0.5%	44.0%
2004	455,201	11.9%	5.3%	2.8%	0.11	46.2%	0.6%	46.8%
2005	498,755	12.1%	5.4%	2.9%	0.12	44.6%	0.6%	45.2%
2006	581,348	11.9%	5.6%	3.0%	0.12	45.7%	0.6%	46.3%
2007	590,431	10.9%	5.2%	3.1%	0.13	41.0%	0.5%	41.5%
2008	571,112	9.6%	4.7%	3.3%	0.13	34.8%	0.4%	35.2%
2009	428,277	8.2%	3.6%	3.6%	0.16	22.5%	0.3%	22.8%
2010	546,456	8.9%	4.2%	3.9%	0.17	25.1%	0.4%	25.5%
2011	672,191	9.8%	4.7%	4.0%	0.17	27.9%	0.4%	28.3%
Average						**36.8%**		**37.3%**
Non-PEMEX								
2003	2,735,997	88.2%	36.2%	97.3%	4.09	8.9%	0.6%	9.4%
2004	3,357,537	88.1%	39.2%	97.2%	4.05	9.7%	0.6%	10.2%
2005	3,618,719	87.9%	39.1%	97.1%	4.03	9.7%	0.5%	10.2%
2006	4,308,619	88.1%	41.5%	97.0%	3.95	10.5%	0.6%	11.1%
2007	4,812,545	89.1%	42.5%	96.9%	3.93	10.8%	0.6%	11.4%
2008	5,360,974	90.4%	44.0%	96.7%	3.99	11.0%	0.6%	11.7%
2009	4,791,926	91.8%	40.1%	96.4%	4.30	9.3%	0.5%	9.9%
2010	5,565,340	91.1%	42.6%	96.1%	4.13	10.3%	0.6%	10.9%
2011	6,202,977	90.2%	43.1%	96.0%	4.04	10.7%	0.6%	11.3%
Average						**10.1%**		**10.7%**

Source: Authors' calculations using PEMEX and SHCP data.

The rates of return to capital for PEMEX are higher than the rest of the private sector. As we can observe in Table 12, if we disaggregate both income and capital shares into the private sector and PEMEX, we obtain separate and composite rates of return. From the results, we can see that the rates of return to capital are quite high for PEMEX, as the capital stock itself is small compared to the rest of the private sector. The estimated rates of return to PEMEX have been declining since 2007. Although the PEMEX rates of return on capital are on average 37 percent (and declining), their contribution to the overall returns in the economy is small due to its capital size and participation in gross operating profits in relative terms. Nevertheless, we can see the effect that PEMEX has on the rest of the economy: it makes the EOCK or the discount rate slightly higher because of its relatively high share in investment.

Table 13 The impact of PEMEX on the EOCK: Rates of return and tax distortions relating to PEMEX and non-PEMEX entities, 2003–2011

Breakdown by entity type	2003–08	2009–11	2003–11
PEMEX			
Taxes paid out of profits as a share of total tax revenue of Mexico	31.9%	28.3%	30.6%
Taxes as a share of assets	71.4%	43.6%	62.1%
After-tax return on assets	−1.8%	−1.8%	−1.8%
Required return on assets	9.5%	9.5%	9.5%
Capital tax distortion (including share of indirect product market taxes)	**60.0%**	**32.3%**	**50.8%**
Non-PEMEX			
Capital income and property taxes as a share of assets	0.5%	0.6%	0.5%
Capital tax distortion (including share of indirect product market taxes)	**1.1%**	**1.0%**	**1.1%**

Source: PEMEX accounts; SHCP; OECD Tax Data.

To assess the impact of PEMEX on the EOCK, we disaggregate investment flows for PEMEX and other sectors. Assuming the same elasticity of demand for investment funds as the rest of the private sector (See Table 14), we recalculate the weights in this scenario for PEMEX, other investments, domestic savings, and foreign savings. The averages are included in Table 15. With the assumptions above, we generate the new weights and apply these to the tax distortions reported above for the four sectors (PEMEX, other investors, domestic savers, and foreign savers). The results, reported in Table 15, show a higher EOCK externality of 2.4 percent. The size of the PEMEX distortion has fallen in recent years as a result of its declining surpluses—a

trend that could potentially continue over the long term—which suggests a more reasonable estimate of the economic externality of close to 2 percent.

Table 14 Investment and savings shares and assumed elasticities for the disaggregated scenario, 2003–2011

	PEMEX investment over GDP	Other private + inventory investment over GDP	DS/ GDP	FS/ GDP	η PEMEX	η (rest)	Eds	Efs
2003	1.5%	17.6%	22.9%	1.1%	−1	−1	0.3	3
2004	1.4%	19.1%	24.9%	0.9%	−1	−1	0.3	3
2005	1.4%	18.4%	24.4%	1.0%	−1	−1	0.3	3
2006	1.4%	20.4%	26.2%	0.8%	−1	−1	0.3	3
2007	1.5%	20.4%	26.5%	1.4%	−1	−1	0.3	3
2008	1.7%	19.6%	26.9%	1.8%	−1	−1	0.3	3
2009	2.1%	15.5%	23.8%	0.8%	−1	−1	0.3	3
2010	2.1%	16.0%	23.9%	0.2%	−1	−1	0.3	3
2011	1.9%	18.0%	25.1%	0.9%	−1	−1	0.3	3
Average	1.7%	18.3%	24.9%	1.0%	−1	−1	0.3	3

Source: Authors' calculations using PEMEX and SHCP data.

Table 15 Disaggregating PEMEX and the estimation of the EOCK tax externalities per unit of capital

	PEMEX investment	Other investment	Domestic savings	Foreign savings
	f0	f1	f2	f3
Average weights	5.5%	60.2%	24.7%	9.6%
Distortions/unit	32.3%	1.1%	−0.8%	1.4%
EOCK externalities/unit of capital				**2.4%**

Source: Authors' calculations on the basis of previous tables.

The reason for the increase in the tax externality when PEMEX is separated out is that PEMEX not only has a high tax distortion, but the investment share of PEMEX is higher than its asset share—over the 2003–2011 period it averaged 4.1 times higher. This higher investment share puts a relatively higher weight on the PEMEX distortion when it is disaggregated and assumed to respond to the market in the same way as other investors. If PEMEX investment is, in fact, less responsive to changes in the cost of capital than other business entities in Mexico, then the tax externality will be lower, as can be seen in Table 16. For

a lower (in absolute terms) investment elasticity of (−0.5) for PEMEX and a slightly higher one of (−1.5) for non-PEMEX entities, we would still obtain a per unit capital externality of 1.4 percent.

Table 16 Sensitivity of the EOCK tax externalities/unit of capital to investment elasticities by PEMEX and non-PEMEX entities

		Rest of the economy investment elasticity		
		−0.5	−1	−1.5
PEMEX investment elasticity	0.0	0.4%	0.6%	0.7%
	−0.5	1.7%	1.5%	1.4%
	−1.0	2.9%	**2.4%**	2.1%

5 Conclusions

The main weakness of the traditional top-down single value approach to the EOCK is that it has difficulty in accommodating the different capital mobilization transaction costs and, more importantly, the different systematic risk premiums required on capital funds supplied to different types of project investments. While the average commercial project (essentially financed in the long run by market sales revenues and using average debt leverage) bears the market risk premium on its equity, projects bearing more or less market risk will face higher or lower systematic risk premiums, or, in other words, their EOCK will vary accordingly to reflect the changes in costs incurred on capital financing. By contrast, all routine projects (non-mega projects with modest unsystematic project risks) ultimately financed out of government revenues (largely taxes) will bear no systematic market risk premium, such that the costs of capital supplied in a competitive market will be lower than the commercial projects.

Hence, there are arguments for having two discount rate regimes: one for public sector projects funded out of budget resources, and the other for public sector market-oriented projects. For the latter, the EOCK would either be based on a weighted average cost of capital plus the economic externality per unit of capital or on the actual weighted average cost of capital

for each type of commercial project. Nevertheless, the institutional arrangements and capacities in handling a high volume of public investment projects favor using a single EOCK to simplify the project selection process and bring greater transparency and control to the process.

In this study we recommend that a single EOCK rate for Mexico be set at 10 percent. However, it is also recommended that a degree of flexibility be allowed for the upward adjustments to the EOCK in the case of large-scale commercial projects in regulated sectors or PPPs, where above-average systematic market risks increase the costs of finance.

A number of areas would benefit from further research and data gathering in order to sharpen the EOCK estimates. These include, first, data on the tax revenues raised yearly from domestic and foreign savings, in order to more accurately estimate the externalities involved in using additional domestic and foreign savings. Second, more details about the breakdown of domestic savings between households, corporations, and the government and the portfolio of household savings, which would sharpen the understanding of the importance and returns on domestic savings. Third, a confirmation and understanding of the relatively high investment in added inventories in Mexico, which would be helpful in estimating the stocks of capital.

6 Recommendations for Mexico going forward

Based on the analysis described in this study, we propose the following recommendations:

- **Choice of models:** We recommend that both the traditional weighted average method for the estimation of the single rate and the minimum supply price of capital plus externalities approach be used to check consistency of results. The parameters of these models should be revised and re-estimated at least every five years to take into account the changing macroeconomic and fiscal circumstances in Mexico.

- **Single versus differentiated EOCK:** We recommend a ***single EOCK for all public investment projects at 10 percent***. However, it is also recommended that a degree of flexibility be allowed for the upward adjustments to the EOCK in the case of large-scale commercial projects in regulated sectors or PPPs, where above-average systematic market risks increase the costs of finance.

- **Implications of the economic trends for a forward-looking estimate:** As the world economy pulls back from the monetary stimulus adopted in response to the recent global recession, careful consideration of upward trends in the international cost of funds is required in the adoption of an EOCK rate. In addition, the effects of underlying improvements in capital markets, the possible greater degree of integration of Mexico into international capital markets, as well as the impacts of macro-economic policies in the United States, need to be carefully included in the consideration of the minimum supply cost of funds and the marginal economic costs of foreign savings or borrowing.

- **An improving country risk rating:** Mexico's credit rating has significantly improved since its collapse during the financial crisis of the 1980s (see Annex VIII), which has in turn resulted in lower costs of external as well as domestic funding. Although this positive trend was partially interrupted during the last global financial crisis, after the recovery and the continuation of expansionary monetary policies, especially in the United States, 10-year Treasury bills and corporate rates continued to go down from 2010 to 2012. However, according to the Federal Reserve Bank (capital market rates), there has been a recent upward shift in 10-year Treasury bills, from a low of about 1.5 percent in early 2013 to about 3 percent as of September 2013. These higher rates will affect international markets, including Mexico. While it is expected that international borrowing costs will increase over the medium term, Mexico still has significant upside potential to improve its governance and economic management in order to continue improving its country risk ratings and bring about systematic reductions in its costs of debt and equity financing.

- **Changes in tax distortions:** As a result of the new proposals for fiscal reform, some of the taxes and actual revenue collected will change. These changes need to be considered in any

recalculation of the EOCK. More detail is required on the actual revenue measures and expected revenue impacts. However, rough simulations of a net increase in revenues of 3 percent of GDP over the medium term (as announced in 2013) that is widely spread across the various tax types is expected to raise the EOCK by about 0.2 to 0.3 percentage points. This will ultimately depend on the details of the economic reform package and tax measures, as well as its implementation.

- **Improvements in the financial sector:** From the analysis, we conclude that there is a huge potential for the financial sector to grow in Mexico. The size of the financial sector in relation to GDP is relatively small in the international context. Increased competitiveness, availability of more savings and investment instruments, and greater integration to world markets could lower the cost of capital and reduce the estimated EOCK. The countervailing forces (slightly higher tax externality effects and lower capital costs due to financial sector reforms and greater competitiveness in the sector) will need to be evaluated in the revisions of the EOCK.

- **The impact of reforms:** The impact of the multiple reforms approved in Mexico during the last months is still uncertain and could also affect the EOCK. It is recommended that a reassessment of the EOCK take place in about five years in order to capture the impact of the reforms and the evolution of economic trends and country risk rating.

- **Improvements required in data collection and availability:** In addition to national accounts information and data on labor markets, expanded data collection on country, sector risk, and costs of finance by different instruments and for different sectors and forms of funding will be required so as to improve future estimations of the EOCK. In addition, a clear roster data on tax collection by type of instruments and payers, as well as by type of transactions—especially domestic and foreign savings, as they affect different sectors of the economy—should be developed and maintained using different sources and checking for internal consistency with the national accounts and budgets in the public sector.

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8 Annex section

Annex I Different approaches to estimate the economic opportunity cost of capital (EOCK)

A. Weighted cost of capital method

Example 1:

Invest $\boldsymbol{K}$ (1000), which generates a perpetual stream of net benefits $\boldsymbol{b}$ (200).

Capital is sourced, $\boldsymbol{\omega}$ (20%), from foregone consumption at cost of $\boldsymbol{r}$ (4%) and (1 − $\boldsymbol{\omega}$) (80%) from foregone investment at cost $\boldsymbol{\pi}$ (11.5%).

Weighted average EOCK, $\boldsymbol{e} = \omega \mathbf{r} + (1-\omega) * \pi = 10\%$

$$\boldsymbol{NPV_{econ}} = -\boldsymbol{K} + \frac{\boldsymbol{b}}{\boldsymbol{e}} = -1000 + \frac{200}{10\%} = -1000 + 2000 = 1000$$

This method is clear and provides consistent results in terms of net returns for the selection and comparability of projects. The results are compatible with national accounts and are expressed in the same currency and values as public and private sector budgets.

B. The social rate of time preference (SRTP) or consumption-based appraisal

Example 2:

Invest $\boldsymbol{K}$ (1000), which generates a perpetual stream of net benefits $\boldsymbol{b}$ (200).

Capital is shadow priced at the rate $\boldsymbol{e/r}$ or 10% / 4% = 2.5.

$\boldsymbol{r}$ is the social rate of time preference for consumption.

$$\boldsymbol{NPV_{econ}^{cons}} = -\boldsymbol{K} * \boldsymbol{S} + \frac{\boldsymbol{b}}{\boldsymbol{r}} = -1000 * 2.5 + \frac{200}{4\%} = -2500 + 5000 = 2500$$

This project generates 2500 net present value (NPV) of consumption equivalent units. If you divide the NPV by the shadow price of capital, $\boldsymbol{S}$ = 2.5, you are again at an NPV of 1000, which we obtained in the first example. This procedure, although it can yield the same results under careful considerations, is not intuitively appealing.

The social rate of time preference (SRTP) is used in most European countries as a public investment discount rate in the economic appraisal of investment projects. In fact, it is the recommended approach in EU manuals. For example, the EU guidelines for structural program funds suggest a discount rate of 3.5 percent for the competitive states and 5.5 percent for the cohesion states.

The usual formulation for the SRTP is derived from solving a dynamic optimization model for a typical or representative consumer over an infinite time horizon, subject to a production function that depends on the available capital from foregone consumption. The SRTP or required return on individual savings is typically estimated as the sum of the consumer rate of time preference plus the per capita growth rate in consumption adjusted by the elasticity of the marginal utility of consumption.

This model for estimating the SRTP has a number of simplifications, which result in the omission of several key features of a capital market in its structure, and hence excludes them from consideration in the estimation. In particular, it has the following short-comings: (1) it does not take into account the intermediation costs in capital markets that are part of the economic cost of using capital funds; (2) the model does not recognize the tax and other distortions in the savings and investment markets that put a wedge between the return that savers receive and investors earn from the use of capital; (3) it does not consider the costs of systematic risk arising from country risk (features of political, financial, and economic governance affecting the returns on investments in an economy) or market or sector risks arising from the non-diversifiable component of risks in a market portfolio in an economy; the costs of systematic risk are part of the economic costs of raising and using capital funds; (4) it does not recognize the role of foreign savings in determining the costs of capital used in an open economy and the nature of the economic cost of foreign savings with varying degrees of integration with international capital

markets and the country risks; (5) it does not allow for savings within a lifetime pattern of individual income; individual savers live for finite periods and typically face a range of income profiles (rising and falling over time) and security conditions over their lifetimes which affect their willingness to save.

While in earlier planning models and the related SRTP (such as those derived by Marglin, Sen, and Feldstein in the 1960s) correctly recognized the need to shadow price investment in terms of the foregone consumption—a shadow price significantly larger than one in a distorted capital market—in the use of the SRTP in project appraisal, this key feature has been lost in current usage of the SRTP, such that capital is significantly underpriced. The SRTP is basically operating on values in consumption units so that the correct shadow pricing of capital used is critical to the correct estimation of the net economic benefits of a project.

Overall, the lack of recognition of key features of a capital market in the estimation of the SRTP makes it difficult to conduct any integrated analysis of an investment project. The ability to conduct a distributional analysis that allows an estimation of the net gains (losses) accruing to different financiers and other stakeholders in a project is crucial. In addition, the fact that investment costs have to be multiplied by a shadow price equivalent in consumption units make this method less transparent and more difficult to implement.

C. The discount rate equals the opportunity cost of investment in the private sector

Example 3:

For the same project that invests $\boldsymbol{K}$ (1000), which generates a perpetual stream of net benefits $\boldsymbol{b}$ (200),

Economic discount rate: foregone investment at cost $\boldsymbol{e}$ = 11.5%.

$$\boldsymbol{NPV_{econ}} = -\boldsymbol{K} + \frac{\boldsymbol{b}}{\boldsymbol{e}} = -1000 + \frac{200}{11.5\%} = -1000 + 1739 = 739$$

The NPV is smaller than under the weighted cost method. Some projects could be excluded using this higher rate of discount, which does not take into consideration the other sources of funds for a project, namely domestic and foreign savers.

This method tends to result in higher economic discount rates than the weighted cost of capital, hence potentially excluding some worthwhile projects. In other words, it is not an efficient method from the overall economic perspective, as it dismisses the importance of savings on the cost of capital.

D. The accounting or sliding discount rate

The accounting or sliding discount rate reflects a rationing approach that allows public sector projects to be funded, in descending order, as long as there are available resources in the public sector budget. The accounting rate would be lowered, thus accepting more projects, as long as there are funds in the budget, and vice versa, it would be raised to screen some projects out to meet the budget constraint.

Example 4:
For the same project that invests $\boldsymbol{K}$ (1000), which generates a perpetual stream of net benefits $\boldsymbol{b}$ (200),
Accounting rate $\boldsymbol{AR}$ = 8%.

$$\boldsymbol{NPV_{econ}} = -\boldsymbol{K} + \frac{\boldsymbol{b}}{\boldsymbol{e}} = -1000 + \frac{200}{8\%} = -1000 + 2500 = 1500$$

Result: this would give the same project as in example 1 a higher NPV. Using such a rate could lead to the wrong selection of projects. For example, the accounting rate could go up to 20 percent, and the project would still be feasible (NPV > 0). Overall, the accounting rate is an arbitrary measure, which does not give us robust decision-making criteria.

Annex II The consistency between the minimum supply price of capital approach and the traditional Harberger approach[13]

The consistency between the standard EOCK model shown in section 2.1 above and the supply price approach can be readily shown by recognizing that the economic value of the marginal product of a unit of capital (π) is also equal to the weighted average cost of capital (i_m) plus the tax externalities (and any other externalities such as monopoly rents) per unit of capital (t_d), or $\pi = i_m + t_d$.

Similarly, on the supply or savings side (r), the cost of added savings (including risk and intermediation costs) is the weighted average financial return received by savers—(i_m) reduced by any taxes on the return to savings per unit of capital (t_s) plus any other external costs incurred by the economy. The same principles are applied to externalities from the use of foreign savings. Hence, the standard model presented above can be transformed to:

$$\begin{aligned} EOCK &= \omega^d \pi + \omega^s r \\ &= \omega^d (i_m + t_d) + \omega^s (i_m - t_s) \\ &= i_m + \omega^d t_d + \omega^s (-t_s) \end{aligned}$$

The externalities arise from different types of investment foregone experiencing different tax distortions ($\omega^d * td$) and from different types of saving also experiencing different tax distortions ($-\omega^s * ts$). The economic externality per unit of capital also becomes the weighted average of the externalities in the different sources of capital in exactly the same fashion as shown above in section 2.1.

[13] This annex follows the Glenday (2010) analysis.

$$\omega^d t_d = \sum_{j=1}^{n} \omega_j^d \, t_{dj} = \frac{-\sum_{j=1}^{n} \eta_j^d (I_j / S) t_{dj}}{\sum_{i=1}^{m} \varepsilon_i^s (S_i / S) - \sum_{j=1}^{n} \eta_j^d (I_j / S)}$$

and

$$\omega^s t_s = \sum_{i=1}^{m} \omega_i^s t_{si} = \frac{\sum_{i=1}^{m} \varepsilon_i^s (S_i / S) t_{si}}{\sum_{i=1}^{m} \varepsilon_i^s (S_i / S) - \sum_{j=1}^{n} \eta_j^d (I_j / S)}$$

The expressions for the EOCK above show the equivalence of different ways of expressing the EOCK given the above assumptions about the capital market in the economy. The initial expression of EOCK = $\omega^d \pi + \omega^s r$, or the weighted average of the economic value of the foregone product and the cost of additional savings supplied, characterizes the traditional approach to estimating the EOCK as a national parameter.

Example:

Consider a capital market with all costs of capital equal to a single market interest rate, i_m.[14] Capital investments are subject to a uniform income tax on their returns at tax rate t_c such that all investments have to generate a gross of tax return on investment of: $\pi_c = i_m/(1 - t_c)$. If $i_m = 7\%$ (real or inflation-adjusted) and $t_c = 30\%$, then $\pi_c = 10\%$.

In addition to this gross of tax return, the products of capital investment yield indirect taxes that have to be paid for by the consumers or users of the products. These indirect taxes become part of the economic return on the investment, such that the gross return on investments becomes $\pi =$

[14] All interest rates are expressed here on a real or inflation adjusted basis.

$i_m * (1 + t_i)/(1 - t_c)$, where t_i is the effective indirect tax rate[15] expressed relative to the gross of tax return on investment. If $t_i = 16\%$, then $\pi = 11.6\%$.

Alternatively, this gross return to the economy can be expressed as $\pi = (i_m + t_d)$, where t_d is the tax generated per unit of capital invested or $t_d = i_m * (t_c + t_i)/(1 - t_c)$. For the parameter values in this example, $t_d = 3\% + 1.6\% = 4.6\%$. Savers in this capital market are willing to supply capital based on their net-of-tax returns or $r = i_m * (1 - t_p)$, where t_p is the income tax rate charged on personal savings. If $t_p = 20\%$, then $r = 5.6\%$. Alternatively, this can be expressed as $r = (i_m - t_s)$, where t_s is the tax generated per unit of capital saved or $t_s = i_m * t_p = 1.40\%$. The EOCK of the capital used by a project under the standard weighted average formulation is the economic cost of the share of capital coming from foregone investments, where ω^d is the share from foregone investments that would have earned π, and the economic cost of the share coming from savings, where $\omega^s = (1 - \omega^d)$ is the share from added savings at the cost r. Taking $\omega^d = 0.75$, then EOCK = 0.75 * 11.6% + 0.25 * 5.6% = 10.1%. The final equivalent expression of $(i_m + \omega^d t_d + \omega^s(-t_s)$ gives *the same EOCK value*, or EOCK = 7% + (0.75 * 4.6% + 0.25 * −1.40%) = 7%+ 3.45% − 0.35% = 10.1%.

This calculation breaks out the components in a different way, which is important both from an estimation point of view and for a "reinterpretation" of the meaning of the components of the EOCK to allow for the direct re-entry of the costs of risk and transaction costs back into the estimation of the EOCK. Importantly, the final expression breaks out the private market cost of capital or interest rate (i_m) from the economic externalities of using capital in a project (equal to 3.1% in this example). In addition, the two components are expressed as a rate per unit of capital—in the simple example, 7 percent for the private market cost of capital and 3.1 percent as the economic externality per unit of capital, which in this case represents the net foregone taxes in the rest of the economy by using the capital in the particular project under consideration. The

[15] An estimate of $\boldsymbol{t_i}$ can be gained from the share of indirect taxes attributed to capital ((VAK/TVA)*(Indirect Tax)) relative to the net-of-depreciation value added earned by capital (NVAK) or $\boldsymbol{t_i}$ = ((VAK/TVA)*(Indirect Taxes))/NVAK = VAK/NVAK*(Indirect Taxes)/TVA = $(\boldsymbol{\pi_c} + \boldsymbol{\delta})/\boldsymbol{\pi_c}$*(Indirect Taxes)/TVA, where $\boldsymbol{\delta}$ = depreciation rate and TVA = total value added or GDP at factor cost. If (Indirect Taxes)/TVA = 10%, $\boldsymbol{\delta}$ = 6%, and $\boldsymbol{\pi_c}$ = 10%, then $\boldsymbol{t_i}$ = 16%.

proposed new approach focuses on each component—supply of capital and externalities of the use of capital for the project—separately. For average public sector projects, the EOCK obtained through the traditional weighted cost of capital and the new approach should give consistent results.

On the supply side, two major sources of capital are national and foreign savings. Taking private savings out of total national savings as being price responsive to returns on its investment opportunities, the externality is the tax gain (hence, a reduction in the EOCK) or the average return on market investments (r_m) multiplied by the effective tax rate on these investments (*ts*).

Foreign savings that are responsive to changes in the domestic market returns (that exclude some unresponsive capital flows such as concessional loans to governments or fixed interest rate loans) can generate tax gains to the extent that withholding taxes are charged on repatriated funds, but can also generate losses to the country to the extent that foreign savers earn higher returns on their infra-marginal savings as interest rates rise in the domestic market in response to the added demand for capital funds. The marginal economic cost of foreign capital becomes $\boldsymbol{i}_m^f(1-\boldsymbol{t}_{wh})(1+\boldsymbol{\phi}/\boldsymbol{\varepsilon}_f^s)$ where $\boldsymbol{i}_m^f$ is the market price of foreign savings, $\boldsymbol{t}_{wh}$ is the effective withholding tax rate, $\boldsymbol{\phi}$ is the price responsive share of foreign savings, and $\boldsymbol{\varepsilon}_f^s$ is the price elasticity of supply of foreign savings. Hence, the externality has two parts: a tax gain, $(-\boldsymbol{t}_{wh}\boldsymbol{i}_m^f)$ and the loss of surplus to foreign savers, $\boldsymbol{i}_m^f(1-\boldsymbol{t}_{wh})\,\boldsymbol{\phi}/\boldsymbol{\varepsilon}_f^s$. Importantly, this externality *declines* as the price elasticity of foreign savings increases, but at the same time, the share of the overall economic externality of using capital that arises from the cost of added foreign savings *increases*. In an open economy faced by a fixed price of foreign savings, this share approaches 100 percent and dominates the EOCK, which in the limit becomes $\boldsymbol{i}_m^f(1-\boldsymbol{t}_{wh})$, assuming $\boldsymbol{i}_m^f$ includes any project risks. At the other extreme, in a closed or high risk country, this external cost of foreign savings per unit of capital *rises* as $\boldsymbol{\varepsilon}_f^s$ declines, but its share of the overall externality also *declines*.

The use of the bottom-up approach

The key characteristic of this approach is similar conceptually to the economic price of cement. The economic price of cement will depend upon the transportation costs to the location in which it will be used, while the economic price of capital funds varies between the types of corporate entities and projects raising the funds.

For revenue-financed projects undertaken by the government, the cost of the marginal capital funds is the real interest rate on long-term borrowing paid by the government, which means a single discount rate can be used for all such public sector projects, namely the expected real long-term borrowing costs plus the economic externality arising from the use of capital funds.

As projects become more financed by market revenues and have less regulated market prices, the financiers are more exposed to market risks and the weighted average cost of raising capital rises by the market risk premium appropriate to the sector. Hence, revenue-financed public investments can be expected to have lower EOCK compared to price-regulated utilities, which, in turn, would be expected to be lower than that for the average private sector investment by a traded company. It is critical to note that, to the extent that added revenue-financed government projects demand added public sector tax revenues, particularly for the operating and maintenance funds to sustain their operations, the added use of current revenues needs to be charged at the marginal economic cost of raising public funds. The lower EOCK is somewhat offset by the added cost of raising incremental revenues.

In the Mexican capital markets, the risk premiums are very high, which makes for very large differentials in the costs of capital. While in the United States the government can raise long-term capital funds at about 2 percent, and the market risk premium on traded equities is about 4 percent (or the average real market return is about 6 percent), in Mexico, long-term government debt bears a country-risk premium of about 2 percent (making the real financial cost of government borrowing about 4 percent), but the estimated market premium on equities based on the country risk ratings of Mexico is about 5 percent above the United States, such that the

expected real cost of equity is about 2% + 4% + 5% = 11%. The actual measured real rate of return to stock exchange shares since 2000 is about 14 percent or significantly higher. The lower estimated rate of return in part reflects improved risk rating in Mexico, following its economic recovery since the major financial crisis in the 1980s. Going forward, the realized returns on the stock market should drift downwards towards the 11 percent mark and possibly even lower if the country risk ratings continue to improve.

From the perspective of the EOCK, the high risk premiums in the equity markets make important differences in the market supply cost of capital. The central government can raise long-term capital at about 4 percent (though this cost can be expected to rise in the future, as money markets tighten following the recovery from the recent global recession), but assuming a 70 percent equity and 30 percent debt financing in a typical large private company project that can raise debt financing at about the same real cost as the government, the market weighted average cost of capital (WACC) would be about: 70% * 11% + 30% * 4% = 8.9%. A price regulated utility with higher debt and less risky equity may have a real WACC = 60% * 7% + 40% * 4% = 5.8%. In all cases, the absorption of capital funds from the market would yield a weighted average economic externality of about 2 percent. Hence, the EOCK for the pure public sector project would be at least 4% + 2% = 6%, for the regulated utility it would be 5.8% + 2% = 7.8%, and for the average traded company, 8.9% + 2% = 10.9%. Note that the traditional top-down approach to the weighted average EOCK, which does not adjust for market risk in a particular investment project, is currently yielding an estimate of about 10 percent.

Based on these results, there are arguments for having two discount rate regimes: one for public sector projects funded out of budget resources with a single rate, and the other for public sector market-oriented projects where the EOCK is either based on an average WACC plus the economic externality per unit of capital or based on the actual WAAC for each type of commercial project. Nevertheless, the institutional arrangements and capacities in handling a high volume of public investment projects favor using a single EOCK to simplify the project selection process and bring greater transparency and control to the process. In this case, it is recommended that a single EOCK rate be set at 10 percent, but allowing for flexibility to make upward adjustments to the EOCK in the case of large-scale commercial projects in regulated

sectors or PPPs where above-average costs of systematic market risks are involved in the costs of finance.

It is of interest to note that the most recent estimates of the EOCK for Canada by Jenkins and Kuo (2008), essentially using the top-down approach, have now removed the market risk premium from the returns on private equity investment, such that their latest estimate drops to 7 percent (from 10 percent some years back). Canada has higher tax distortions than Mexico, affecting capital markets at about 2.5 to 3 percent so that their underlying financial cost of capital funds is closer to a low risk financial cost of government funds. This rate, however, would be inappropriate to apply to government decisions for projects that will cause the economy to bear higher costs of systematic risk.

Annex III Potential impacts of the tax/fiscal reform proposals for the EOCK in Mexico

Tax reforms can be expected to change the tax distortions in the markets affected by the use of capital funds, and hence the weighted average tax externality will also be affected; however, an estimation of the changes in tax revenues as a result of the fiscal and tax reforms in Mexico indicates that the net impact on the estimated tax externality per unit of capital will be relatively small. The tax reforms announced to date propose to raise revenues through taxes on capital and labor incomes as well as indirect taxes in the product markets. The modest impacts from the proposed tax increases are expected to raise the tax externality by some 0.1 to 0.3 percentage points.

As an illustration, we assume that 3 percent of GDP in added tax revenues is raised equally through the three tax types. The combination of 1 percent of GDP through taxes on capital and a further 1 percent through indirect taxes would increase the tax distortion on invested capital by about 0.35 percent per unit of total capital (the basic calculation is presented below). Given a weight of about two-thirds on foregone investment in the EOCK, this would raise the EOCK by about 0.23 percentage points. To the extent that taxes on domestic and foreign savings are also increased (the proposed reforms include raising the top tax rate on personal income, taxing capital gains on traded securities, and establishing a special 10 percent corporate tax on dividends and profit distributions), the marginal economic cost of domestic and foreign savings is expected to drop slightly with a corresponding small reduction (or contribution) in the weighted average tax externality. For example, if tax changes increase the effective taxes on both domestic and foreign savings by 1 percentage point, then the change in the weighted average EOCK would go down by 0.03 to 0.02 percent. This indicates that the range of increase in the weighted average tax externality would be between about 0.1 to 0.3 percentage points, depending on the mix of tax changes. Ultimately, the detailed tax proposals will need to be settled, and detailed estimates of the revenue impacts and changes in the effective tax rates—categorized by the major tax types relative to the forecast base case scenarios for the economy—will need to be carried out in order to reach a more accurate estimate of the impact of the tax reforms on the EOCK.

Tax revenue assumptions and impacts

To estimate the impact on the EOCK externality per unit of capital, we assume that a tax increase of about 3 percent of GDP as part of the proposed reforms would result in a total of 22 percent, compared to the 19 percent tax/GDP performance in 2011. For an estimation of a range of impacts, we assume that the 3 percent increase in tax revenues will originate from income taxes on capital at 1 percent of GDP and indirect taxes in the product markets adding up to another 1 percent of GDP. We also assume that other measures will result in taxes on labor and savings, effectively contributing the other 1 percent of GDP in new tax revenues, which will not affect our calculations. As our estimation shows, the range of impacts of the tax reform proposals on the tax externality per unit of capital could range from 0.10 to 0.30 percent, with a median value of about 0.20 percent.

Table III.1 Estimation of the impact of the proposed tax reforms on the EOCK externality per unit of capital

Effects of proposed tax changes as part of the fiscal reform	Incremental tax charged on:			
	Capital income (corporate, property, and other taxes paid out of profits)	Labor and domestic and foreign savings	Indirect taxes in product market	Total
Incremental tax revenue as a share of GDP	**1%**	**1%**	**1%**	**3%**
Contribution to tax distortion on investment	100%	0%	59%	
Tax distortion on capital as share of GDP	1.0%	0.0%	0.6%	1.6%
Private capital (reproducible + land + inventories) over GDP				4.50
Tax distortion over private capital assets				0.35%
Weight on foregone investment in EOCK				66%
Contribution to tax externality per unit of capital				**0.23%**

Change in overall tax externality in EOCK	
Investment	**0.23%**
Domestic savings	**−0.02%**
Foreign savings	**−0.01%**
Economic externality (change)	***0.20%***

Annex IV Adjusting labor shares

Below are the different definitions of the proposed adjustments for labor shares, based on Guerriero (2012).

LS1. The unadjusted labor share is the ratio of the compensation of employees to the value added (net of indirect taxes and consumption of fixed capital).

$$\text{LS (unadjusted) or LS1} = \frac{\text{compensation of employees}}{\text{Value added (- indirect taxes - fixed capital)}}$$

A few adjustments have been suggested. The System of National Accounts (SNA) 1993 method breaks down value added into the following categories: compensation of employees, operating surplus (from rent and capital), and mixed income from the self-employed. The UN National Accounts Statistics provide information on mixed income for a large number of countries.

LS2. A common rule, proposed by Johnson (1954), is to impute two-thirds of self-employment income to labor income, and the rest to capital income. These data have been employed to produce a few 'adjusted' measures of labor share.

$$\text{LS2} = \frac{\text{compensation of employees} + \frac{2}{3}\text{mixed income}}{\text{Value added (- indirect taxes - fixed capital)}}$$

Of course, the main problem with this measure is that the 2/3 value, even if quite realistic, is arbitrary and treats all the countries in the same way. Moreover, given that the division of income remains constant over time, it may ignore possible forces that may shift the balance between labor and capital income over time.

LS3. A second adjustment (Kravis, 1959) consists of attributing all self-employment income to labor income, the rationale being that in developing countries most of the self-employed provide

pure labor services. However, using this approach, the labor share is overstated. In reality, some self-employed businesses do generate and use considerable amounts of capital, even in developing countries.

$$LS3 = \frac{\text{compensation of employees} + \text{mixed income}}{\text{Value added (- indirect taxes - fixed capital)}}$$

LS4. It is also possible to consider self-employment income as composed of the same combination of labor and capital as the rest of the economy's income (Atkinson, 1983; Kravis, 1959). The labor share is scaled up by a factor that takes into account the self-employed, who are attributed a wage equal to the average wage of employees.

$$LS4 = \frac{\text{compensation of employees}}{\text{Value added (- indirect taxes - fixed capital)} - \text{mixed income}}$$

This adjustment assumes that income distribution is approximately the same in private unincorporated enterprises and in large corporations (or in the government sector). In reality, they are very different agents, in terms of size, structure, and labor-intensiveness, and they vary significantly from one country to another.

The main problem related to these three methods of adjustment (LS2, LS3, and LS4) is that they require data on self-employment income. As previously mentioned, the UN National Accounts Statistics tables report the value of 'mixed income' or operating surplus of private unincorporated enterprises (OSPUE) and this category is assumed to represent the overall income of the self-employed. Unfortunately, however, data on this category are not available for every state or territory.

That said, even if problematic, this approach is more reasonable than the previous one, because it allows for the possibility that the self-employed generate some capital income. Moreover, being quite straightforward, it has already been used in the literature (Ryan, 1996; Harrison, 2002).

LS5. An alternative method is needed. Gollin (2002) suggests a fourth adjustment, based on the fact that, even when we do not possess information on income, we may have data on the composition of the workforce. In fact, not only is it easier to collect data on the number of self-employed than on their actual earnings, but studies have also shown that the self-employed tend to under-report their income (Hurst, Li, and Pugsley, 2010). This approach has been widely used in the literature for industrialized countries (Bentolila and Saint-Paul, 2003; Ellis and Smith, 2007) and has been applied by the OECD and the EC in their calculations. The majority of countries report only the operating surplus, recording the income from self-employment together with capital income.

The ILO Yearbooks of Labour Statistics are the most fundamental publications of statistical reference on labor questions. Their country profiles provide statistics on the composition of total employment for nearly 200 countries and territories from 1969 to 2008. Based on the International Classification of Status in Employment (ICSE-1993), they classify the workforce into six categories: (1) employees; (2) employers; (3) own-account workers; (4) members of producers' cooperatives; (5) contributing family workers; and (6) workers not classifiable by status. The members of the last four categories in the classification, together with the employers, hold a 'self-employment job.' They represent those self-employed individuals who produce mixed income, and they are precisely those workers involved in self-employment activities who engage in some form of labor. Gollin's (2002) measurement, therefore, imputes average employees' compensation to all the five categories of self-employment jobs. Thus, all types of workers who are not employees are assumed to receive the same average wages as the employees themselves.

$$LS5 = \frac{\frac{\text{compensation of employees} * \text{total workforce}}{\text{number of employees}}}{\text{Value added (–indirect taxes - fixed capital)}}$$

Because of greater availability of data, this approach is preferred to the previous ones. Moreover, especially in countries where the number of self-employed individuals is very large, it may

provide a better approximation of the actual value of the labor share. The advantage is that it considers the composition of the workforce in the different countries and in the different periods of time. The disadvantage is that it requires detailed micro-data. It may also be problematic if there are systematic differences between the employees and the self-employed.

LS6. As a further adjustment, this study proposes one last measurement that completely removes the income earned by the "employers" from the adjusted numerator. LS6 attributes the average employees' wage to all those workers who hold self-employment jobs but are not classified as "employers" (therefore, categories 3, 4, 5, and 6 in the ICSE-1993). They only represent the self-employed who produce mixed income.

$$LS6 = \frac{\frac{\text{compensation of employees}}{\text{number of employees}} \cdot (\text{total worforce} - \text{employers})}{\text{Value added (}-\text{indirect taxes - fixed capital)}}$$

Mexico: Labor shares of value added	1980–2008
LS1	0.35
LS2	0.53
LS3	0.61
LS4	***0.48***
LS5	***0.60***
LS6	0.57

Source: Guerriero (2012).

Annex V Elasticity studies

This annex includes some references to the literature covering supply and demand elasticities.

V.1 References for the elasticity of supply of domestic savings

For Mexico, the study by Héctor Félix Cervini Iturre (2004) adopts and simulates elasticities of supply of domestic savings of 0.10 and 0.30.

Boskin (1978), using U.S. annual national accounting aggregate data and market returns (Moody's AAA-rated bonds and Standard and Poor's municipal bonds) for the 1929–1969 period, found that the estimates of the after-tax rate of return elasticity of private savings ranged from 0.2 to 0.4.

Using U.S. National Accounts Data, Summers (1981) estimated that elasticity values were close to 1. Using the same data, Hall (1988) obtained values in the range from 0.1 to 0.4 for the interest elasticity of savings.

Campbell and Mankiw (1989) modified the Hall model and, using an imputed rent on durable goods as a proxy for the interest rate, found values in the range between 0.23 and 0.50 using different specifications.

Patterson and Pesaran (1992) re-estimated the Hall (1988) model, by applying the instrumental variable moving averages (IVMA) technique, and obtained elasticity values of 0.31 for the United Kingdom, and values between 0.27 (for savings accounts) and 0.35 (for 90-day Treasury bills) for the United States.

Echenique (1995) estimates the intertemporal substitution elasticity of consumption in Uruguay on the basis of monthly data for the period from January 1994 until October 1997, obtaining values of 0.285 and 0.357 for the elasticity of savings. He defined the interest rate as the real

yield of average fixed-term deposits in foreign currency (after correcting for U.S. inflation) and, respectively, using a one and two lag specification for the consumption utility function.

Noya, Lorenzo, and Grau-Pérez (1998) examined the determinants of domestic savings in Uruguay by testing the permanent income hypothesis, using a series of equations for key variables (income, consumption, and interest rate), on annual data for the 1955–1984 period. For the interest rate, they used the expected interest rate yield on deposits denominated in domestic currency. Inflationary expectations were forecast on the basis of auto regressive models. Their values for the elasticity of savings with respect to the interest rate ranged from 0.2 to 0.3.

In an EOCK study on Uruguay, Alberto Barreix (2003) adopts an elasticity of 0.3.

In their study of the EOCK for Indonesia, Jenkins and El-Hifnawi (1993) adopt an elasticity of 0.50 for domestic savings.

Additional results are presented out of a survey from the Federal Reserve Board of the United States (Elmendorf, 1996).

Table V.1.1 Estimates of the intertemporal elasticity of substitution, several studies

Study	Estimate (standard error)	Consumption data; rate-of-return data [a]
Hall (1988)	0.35 (.34) 0.27 (.33) 0.07 (.05)	Semiannual NIPA data; Treasury bills, savings accounts, and stocks, respectively
	−0.40 (.20) [b]	Annual NIPA data; Treasury bills
	−0.03 (.38) [b] 0.03 (.10)	Monthly NIPA data; Treasury bills and stocks, respectively
	0.10 (.23)	Quarterly NIPA data; Treasury bills
Campbell and Mankiw (1989)	0.14 [c] 0.17 [c] 0.05 [c]	Quarterly NIPA data; Treasury bills [d]

Shapiro (1984)	26.5 (28.6) 20.4 (27.1)	PSID data for all households; Treasury bills [e]
Zeldes (1989)	0.37 (.24) −1.46 (.36) 1.92 (.81)	PSID data for households with low wealth-income ratios; Treasury bills [f]
	0.43 (.31) 1.44 (1.34) 0.58 (.32)	PSID data for households with high wealth-income ratios; same [f]
Runkle (1991)	0.45 (.16) 0.35 (.16) 0.49 (.20) 0.49 (.17) 0.49 (.17) 0.43 (.16) 0.48 (.17) 0.48 (.17)	PSID data for all households; savings accounts [d]
	0.30 (.23) 0.28 (.22) 0.23 (.22) 0.28 (.22) 0.31 (.22)	PSID data for households with low wealth-income ratios; same [d]
	0.68 (.27) 0.67 (.26) 0.54 (.25) 0.67 (.26) 0.56 (.25)	PSID data for households with high wealth-income ratios; same [d]
Lawrence (1991)	0.54 (.40) 0.73 (.70)	PSID data for all households; Treasury bills and savings accounts, respectively [g]
	0.54 (.88) 0.46 (1.50)	PSID data for households with below-median income; same [g]
	0.81 (.49) 1.80 (.89)	PSID data for households with above-median income; same [g]

Dynan (1993)	0.10 (.09) 0.11 (.85) 0.12 (.87)	CEX data for all households; Treasury bills
Attanasio and Weber (1993)	0.35 (.13) 0.33 (.10)	British National Accounts data; savings accounts [e]
	0.37 (.18) 0.29 (.15) 0.38 (.21) 0.29 (.25)	FES data for all households; same [e]
	0.60 (.33) 0.63 (.28) 0.78 (.28) 0.73 (.27)	FES data for middle-aged cohort; same [e]
	0.56 (.20)	FES data for young cohort; same
	0.32 (.36)	FES data for old cohort; same
Attanasio and Weber (1995)	0.39 (.28) 0.34 (.28) 0.15 (.35) 0.39 (.21) 0.48 (.28) 0.33 (.32) 0.56 (.22) 0.67 (.19)	CEX data for all households; municipal bonds [e]

a. The studies use the real after-tax rate-of-return. PSID is the Panel Study of Income Dynamics; CEX is the Consumer Expenditure Survey; and FES is the British Family Expenditure Survey. Only estimates based on instrumental variables are included because of the endogeneity that arises in estimating Euler equations.
b. Hall notes that a negative estimate "cannot be taken literally since it implies nonconcave utility." Instead, he concludes that "the case for a significantly positive value . . . cannot be made" here (p. 353).
c. In this model, the elasticity is a nonlinear function of the coefficient on the interest rate and the coefficient on contemporaneous income. Standard errors for the elasticity estimates are not available, but they are presumably fairly large because the coefficient on the interest rate alone is always less than its standard error.
d. Different estimates arise from alternative instruments.
e. Different estimates arise from alternative specifications.
f. Different estimates arise from alternative ways of splitting the sample.
g. Only estimates that include time dummies to control for aggregate shocks to consumption are included.

Source: Elmendorf (1996), Table 1.

V.2 References for the elasticity of demand for investments

Brahima Coulibaly and Jonathan Millar (2007) estimate the long-run elasticity of the demand for fixed nonresidential capital (both equipment and structures) to changes in its interest rates using a quarterly panel of two-digit manufacturing data from South Africa from 1970 to 2001. The authors find highly significant estimates of the user cost elasticity, in the order of **−0.80.**

For the estimation of the EOCK of Uruguay, Barreix (2003) uses several studies and adopts a base value Ed = −1.0 and a range of values of demand elasticity between −0.80 and −1.20.

Cartes, Contreras, and Cruz (2005) from the Universidad de Chile's Centro de Gestión (CEGES), conduct an estimation using different models, which result in values for elasticities in the range of −0.69 to −1.40 with a median value of −1.05.

Kuo, Jenkins, and Mphahlele (2003), using a number of international empirical studies, set the demand elasticity for private sector capital in response to changes in the cost of funds at −1.0.

The Asian Development Bank (1997) recommends the demand elasticity for private sector capital of −1.0 for the EOCK for Bangladesh, Indonesia, and the Philippines.

Jenkins and Kuo (2008) carry out an estimation using a value for the demand elasticity for domestic investment of −1.0.

V.3 References for the elasticity of foreign supply of capital

Barreix (2003) supports the adoption of three values (1.0, 1.5, and 2, respectively) for the supply elasticity of foreign capital stock in Uruguay to undertake sensitivity analysis.

Cartes, Contreras, and Cruz (2005) estimate that the elasticity of foreign savings is in the range between 2.15 to 180.

Kuo, Jenkins, and Mphahlele (2003) set the supply elasticity of the stock of foreign funds at 1.5.

The Asian Development Bank (1997) recommends the supply of foreign savings elasticity of 1.5 when calculating the EOCK for Bangladesh, Indonesia, and the Philippines.

Jenkins and Kuo (2008) use a supply elasticity of foreign funds of 1.5.

V.4 Importance of foreign savings and the elasticity of foreign savings

Annual foreign savings are the amount of net inflows of foreign capital funds (debt, portfolio investments, direct investment, etc.) into Mexico reduced by the amount of net outflow of investment by Mexicans outside of Mexico and by the net amount taken into foreign reserves. The table below shows the average flows over the 2003–2011 period of these components of foreign savings as shares of GDP, total savings, and foreign savings. Foreign savings were 1 percent of GDP and 3.9 percent of total savings. While these flows of foreign savings are relatively small, the flows of the components of savings are larger. Foreign capital net inflows were 4.3 percent of GDP and 16 percent of total savings, while domestic net outflows were 2.2 percent of GDP and 8.4 percent of total savings.

Importantly, the responsiveness of foreign savings to changing returns to capital is a function of the responsiveness in these two underlying capital flows. Relatively small changes in foreign net inflows and domestic net outflows respond significantly to changes in the returns to investments in Mexico, as these are leveraged by the shares of these flows relative to foreign savings. Foreign net inflows were 422 percent and domestic net outflows were 214 percent of foreign savings. As a result, relatively small elasticities of foreign net inflows and domestic net outflows with respect to Mexican returns on investment can result in high responsiveness in foreign savings. For example, for elasticities of 0.5 and −0.5, respectively, the elasticity of foreign savings would be 3.2, and for elasticities of 1 and −1 respectively, it would be 6.4. Hence, despite the relatively small share of foreign savings in total savings, their high responsiveness to changes in returns to investments results in their having a much higher relative share in the estimation of the EOCK.

Table V.4.1 Composition of foreign savings in Mexico: Average of annual flows, 2003–2011

	Foreign capital net inflows	Domestic capital net outflows	Net additions to foreign reserves	Foreign savings
% GDP	4.3%	−2.2%	−1.1%	1.0%
% total savings	16.6%	−8.4%	−4.3%	3.9%
% foreign savings	422.8%	−214.6%	−108.9%	100.0%

Source: Authors' calculations; Banco de México data.

Annex VI Elasticity of demand for investment based on production functions

Price elasticity of demand for investment capital based on microeconomic relationships

An alternative approach to estimating the price elasticity of demand for capital investment (η_{Kr}) is from the relationships of the derived demand for capital of profit maximizing businesses in competitive markets. Basic profit maximizing theory has been used to derive the price elasticity of demand relative to the following parameters of producers using labor and capital as the factors of production.

η_{Qp}	Elasticity of demand for the quantity of output produced relative to the product price
σ_{KL}	Elasticity of substitution of labor for capital
α_K	Share of value added accruing to capital
ε_{Lw}	Elasticity of supply of labor relative to the wage rate

The derived price elasticity of demand is found to be the following:[16]

$$\eta_{Kr} = \frac{\sigma_{KL}(\eta_{Qp}-\varepsilon_{Lw})+\varepsilon_{Lw}(\eta_{Qp}+\sigma_{KL})\alpha_K}{(-\eta_{Qp}+\varepsilon_{Lw})+(\eta_{Qp}+\sigma_{KL})\alpha_K} \qquad \text{(A)}$$

This relationship has a number of special cases, namely:

If $\varepsilon_{Lw} = \infty$, or wage rate are fixed, then $\eta_{Kr} = \alpha_K \eta_{Qp} - (1-\alpha_K)\sigma_{KL}$

$\varepsilon_{Lw} = 0$ $\qquad \frac{1}{\eta_{Kr}} = \frac{\alpha_K}{\eta_{Qp}} - \frac{1-\alpha_K}{\sigma_{KL}}$

[16] J.R. Hicks. 1963. *The Theory of Wages.* Macmillan & Co., 2nd ed.

$$-\eta_{Qp} = \sigma_{KL} \qquad \eta_{Kr} = -\sigma_{KL} = \eta_{Qp}$$

$$\sigma_{KL} = 0 \qquad \eta_{Kr} = \frac{+\varepsilon_{Lw}\eta_{Qp}\alpha_K}{-\eta_{Qp}(1-\alpha_K)+\varepsilon_{Lw}}$$

From the relationships above, the price elasticity of demand for capital depends primarily on the price elasticity of demand for the product and the elasticity of substitution between labor and capital. Generally, when looking at the price elasticity of demand for large aggregates of output, this value is expected to converge on 1 (negative) as the aggregation of goods expands out to the full expenditure budget. Hence, in the case of full private sector production, it is expected that the price elasticity of demand is close to −1. In addition, the elasticity of substitution of labor for capital is expected to be less than 1.

Table VI.1 below gives the sensitivity of the price elasticity of demand for capital relative to a range of parameter values in relationship (A). The results below show that, unless one or both of the price elasticity of demand for output and the substitution elasticity between labor and capital have magnitudes above unity, then the expected price elasticity of demand for capital falls at or below unity in magnitude.

Table VI.1 Sensitivity of elasticity of demand for investment capital relative to key determinants

η_{Qp}	−1	−1	−1	−1	−1	−1	−1.25	−1.25	−1.25
σ_{KL}	1	0.75	1.25	0.75	0.75	0.75	1	0.5	0.5
α_K	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
ε_{Lw}	1	1	1	0.5	0	100	1	1	0
η_{Kr}	**−1.00**	**−0.88**	**−1.11**	**−0.88**	**−0.87**	**−0.89**	**−1.13**	**−0.84**	**−0.75**

Annex VII Arguments for land valuation in capital stocks

Regarding the calculation of the marginal productivity of capital, Caselli and Feyrer (2007) state the following (537–8):

> *Things begin to change dramatically when we add land and other natural resources as possible inputs. This obviously realistic modification implies that standard measures of the capital share (obtained as 1 minus the labor share) are not appropriate to build a measure of the marginal productivity of reproducible capital. This is because these measures conflate the income owing to capital accumulated through investment flows with natural capital in the form of land and natural resources. By using data recently compiled by the World Bank, we are able to separate natural capital from reproducible capital and calculate the share of output paid to reproducible capital that is our object of interest. This correction alone significantly reduces the gap between rich and poor country capital returns. The main reason for this is that poor countries have a larger share of natural capital in total capital, which leads to a correspondingly larger overestimate of the income and marginal-productivity of reproducible capital when using the total capital-income share. The correction also reduces the GDP loss due to MPK differences to about 5 percent of developing country GDP, one fifth of the amount implied by the naive calculation.*

Table VII.1 Proportion of different types of wealth in total wealth, 2000

Variable	Mean	Standard deviation	Median	Weighted mean [a]	Corr w/ log(GDP) [b]
Subsoil resources	10.5	16.4	1.5	7.0	−0.13
Timber	1.7	2.6	0.8	0.9	−0.34
Other forest	2.2	5.4	1.1	0.3	−0.49
Cropland	11.4	15.2	5.1	3.2	−0.73
Pasture	4.5	5.4	2.7	1.9	−0.00
Protected areas	1.9	2.5	0.3	1.4	0.01
Urban land	13.1	4.6	13.5	16.5	0.70
Reproducible capital	54.8	19.2	56.3	68.6	0.70

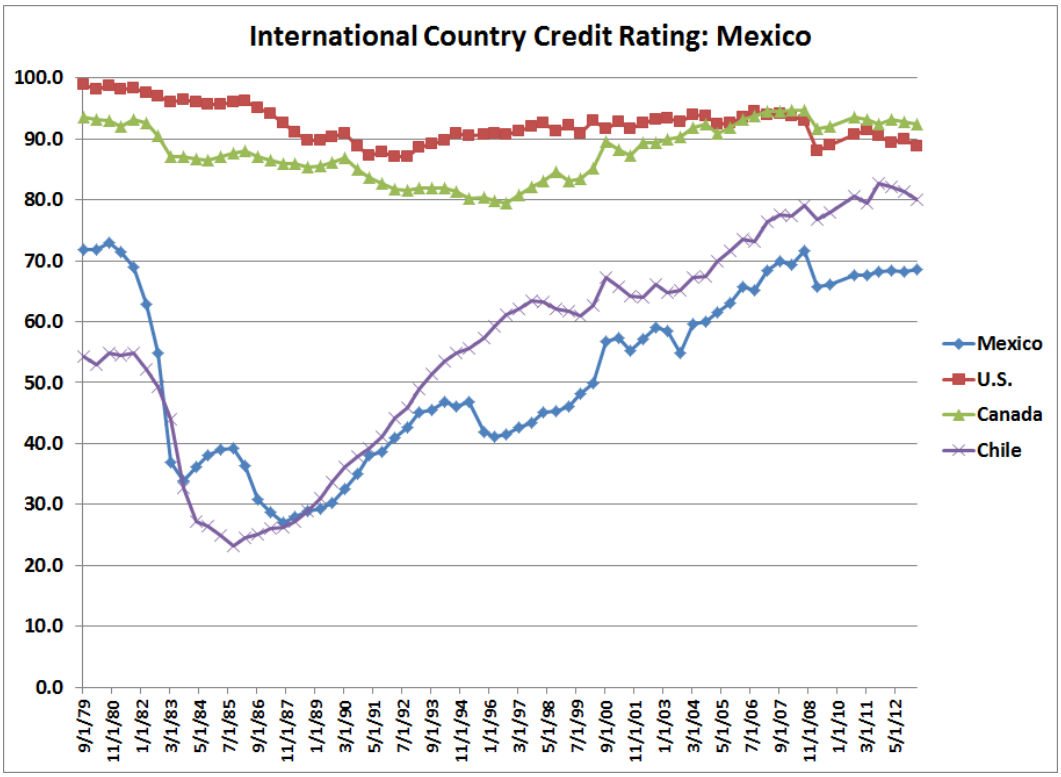
a. Weighted by the total value of the capital stock.
b. GDP is per worker.

Source: Caselli and Feyrer (2007), Table 1.
Note: In this report, the weighted mean values are used to assess the share of urban land in total capital stocks.

Annex VIII Risk issues

Recent trends in country risk and cost of funding for Mexico

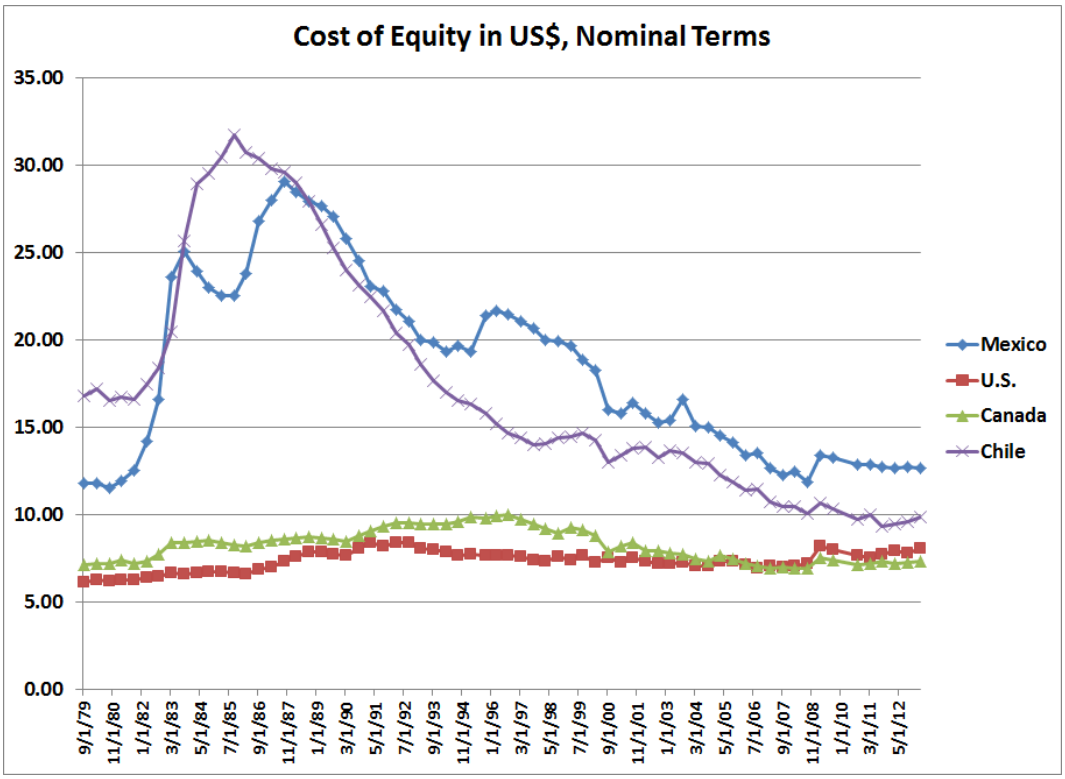
According to the methodology developed by Erb, Harvey, and Viskanta (1995), the current differentials in country credit rating (IICR of 89 for the United States and 68 for Mexico), result in a risk spread of about 5 percent in nominal terms between Mexico and the United States. These rates are used to assess the EOCK tax externality and the rates of interest for the calculation of the EOCK for Mexico.



Source: Institutional Investor.

As can be seen from the upper figure, the credit rating for Mexico has been improving since the mid-1980s (from 30 to 70).

Correspondingly, the equity rates of return or cost of equity estimated for investors in US$ in nominal terms, show a significant decline up to 2012.



Source: Authors' calculations using Erb et al. (1995) methodology and Institutional Investor data.

The methodology to calculate cost of equity traces the average real returns of the Mexican Stock Exchange (MXXD) on a decade-by-decade basis.

Table VIII.1 Real rates of return to equity

Real rates of return	Averages	Decade
MXXD Mexican stocks	10.0%	1970s
	24.2%	1980s
	17.1%	1990s
	14.3%	2000s

Source: Authors' calculations using Mexican Stock Exchange data.

Annex IX Real return on housing

The stock of housing is calculated using the perpetual inventory method, consistent with the capital stock calculations for the rest of the economy. Dividing gross value added for housing over the capital stocks, we obtain the rates of return in the last column, with an average value of 8.3 percent, which is used in Table 11 of the text.

Table IX.1 Real rate of return on housing, 2003–2011

Year	Housing investment over GDP	Housing + land over GDP	Housing stock + land over GDP	Private capital + land + inventories over GDP	GDP	GVA housing	Housing real rate or return; GVA housing/ housing stocks + land
2003	5.3%	6.6%	1.21	4.20	7,555,803	796,264	8.7%
2004	5.5%	6.9%	1.26	4.16	8,574,823	882,985	8.2%
2005	5.5%	6.9%	1.25	4.15	9,251,737	958,469	8.3%
2006	5.8%	7.2%	1.31	4.07	10,379,091	1,051,038	7.7%
2007	5.7%	7.1%	1.30	4.06	11,320,836	1,122,930	7.6%
2008	5.8%	7.3%	1.32	4.12	12,181,256	1,210,219	7.5%
2009	5.0%	6.3%	1.14	4.46	11,937,250	1,218,135	9.0%
2010	4.7%	5.9%	1.07	4.30	13,071,597	1,269,831	9.1%
2011	4.7%	5.9%	1.08	4.20	14,395,833	1,334,523	8.6%
Average							**8.3%**

Source: Authors' calculations, national accounts data, SHCP.